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The Effect of Deductive-Inductive Learning Approach on Creative Thinking Ability and Learning Motivation

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ABSTRACT

Mathematics learning can impact the development of one's mindset in the learning environment. This process is obtained through teacher innovation which provides learning with various methods and approaches that align with what will be taught. Inductive-deductive is an approach that can help students' creative thinking processes and increase learning motivation. For this reason, this study wanted to see how effective and influential this approach is on the ability to think creatively and motivation to learn. The method used is a significant test using one sample t-test and one paired sample t-test. The results obtained are t_{count} values of 2.09 and 10.66 for the inductive-deductive class and -0.848 and -0.94 for the conventional class where the t_{table} value is 1.684. Whereas to see the effect of the approach obtained values of 6.149 and 6.344 with a t_{table} of 1.960. The value that is greater than the t_{table} states that the class is effective and has influence, so it can be concluded that the inductive-deductive approach is effective for critical thinking skills and learning motivation, while conventional classes are not used effectively. The inductive-deductive approach also influences students' creative thinking abilities and learning motivation.

A. INTRODUCTION

The development of a nation is strongly influenced by the academic ability of human resources in it. Creating reliable human resources to compete in the work world or solve problems must prioritise education's role in the process (Alpian et al., 2019, pp. 2-3). Education provides a change in a person's character for the better. Hadi (2021, p. 11) states that a person's cognitive ability can improve with character in him. This character can be built through the habit of being proficient at solving problems and reasoning well under challenging conditions, thinking critically in solving a problem, and having patience in solving existing problems (Thanheiser, 2023, p. 3). These habits can be obtained entirely in learning mathematics.

Learning mathematics can impact the development of one's mindset in a learning environment by involving interaction between teachers and students. This process is obtained through teacher innovation, which provides learning with various methods and approaches that are by what will be taught. The selection of the appropriate course will have a positive influence on improving learning outcomes. Proper practices or procedures in learning can also influence improving creative thinking processes; if students can manage their way of thinking creatively, they will be more proficient in forming new ideas. Students can process problems well by forming conjectures that will be proven to find solutions (Suherman & Vidakovich, 2022, pp. 3-6). The ability to think creatively can positively impact increasing motivation in learning. Learning motivation is a driving force for someone to be enthusiastic and interested in learning. Low stimulation can cause the teaching and learning process to be unmeasurable and affect learning achievement (Yudha et al., 2022, pp. 148-149). Therefore it is essential to increase creative thinking to motivate students to learn. The better the students' motivation in learning, the better the creative thinking process will be obtained.

As previously explained, the appropriate approach to learning influences creative thinking processes and student learning motivation and will influence student learning outcomes. Teachers can adopt many approaches in learning scenarios with various characteristics and advantages. One approach to learning mathematics is the inductive-deductive learning approach. The inductive-deductive learning approach is a combination of two approaches, namely the deductive approach and the inductive approach, where in the

process, this approach emphasises learning that begins with a concrete introduction to the abstract and then provides concrete examples of the results of the generalisation (Winarso, 2014, p. 104). The learning process using an inductive-deductive approach should be able to influence students' creative thinking processes in formulating concrete things to abstract and provoke students' creative thinking to find examples of generalisation results. In line with this, it can undoubtedly increase student motivation to participate in learning.

This research aims to describe the effectiveness of the inductive-deductive learning approach to creative thinking skills and learning motivation and the effect of the inductive-deductive learning approach on creative thinking skills and learning motivation.

Inductive-Deductive Approach

An inductive-deductive approach is an approach that combines the advantages of the inductive method and the deductive system. The inductive-deductive process in learning begins by giving real/concrete examples and then requiring students to find, identify, interpret, and differentiate these examples so that they can generalise into more abstract conclusions, then through these conclusions, students can provide examples of generalisations (Lestari, 2015, p. 130).

Adaptation of the inductive-deductive approach in learning mathematics can be through giving concrete cases that aim to guide students to conclude the completion of the case and deductively prove the truth of the conclusions that have been prepared (Winarso, 2014, p. 105). An inductive-deductive approach is an approach that combines two stages of the learning process at once in which students are required to think specifically in general and are led back to believe specifically.

The inductive-deductive approach also has characteristics to differentiate it from other methods. According to Wardani & Kusuma (2020, pp. 70-71), the criteria for an inductive-deductive system are as follows:

1. Students are active in issuing ideas;
2. The thought process develops from being specific to being more general and concluding to being more specific;
3. Students reason well;
4. Motivated to solve problems;
5. Opportunity to develop broader creative thinking;
6. Involved with activities related to objects, data, materials, patterns, etc;
7. Organizing classes can be individual, cooperative, or classical;
8. Opportunity to communicate broader learning outcomes

Winarso (2014, pp. 106-108) describes the steps of the inductive-deductive approach through four stages: the preliminary stage, the exploration stage, the concept introduction stage, and the concept application stage. The primary stage is carried out to determine how far the students' initial abilities are so that the teacher can condition students to accept new knowledge. This stage is done by giving questions and answers and fostering children's motivation to receive lessons. The exploration stage emphasises solving the problems presented by the teacher. The teacher provides a phenomenon, an example, and not an example where it is intended to provoke students' creative thinking. Students are asked to observe, identify patterns and variables and then communicate what they find. Misconceptions can occur at this stage, so the role of the teacher as a facilitator is highly expected in this regard.

The third stage is introducing and forming concepts; at this stage, the teacher guides students to find conclusions from the results of the exploration that students do, and students are given more opportunities to seek and find advanced concepts. The fourth stage is the concept application stage, where at this stage, students are invited to find case examples from the results of previous conclusions and ask them to solve these problems with the concepts and contexts discussed previously.

Creative Thinking

The learning process, which aims to develop student creativity and increase motivation during learning, is the final process expected of the ability to think creatively (Faturohman & Afriansyah, 2020, p. 108). Well-developed creative thinking skills can form a critical mindset in developing ideas. Students' understanding of mathematics improves if mathematical concepts can be related well (Ningsih, 2014, pp. 3-5). Creative thinking requires the proper methods and approaches so the learning process goes as expected. An appropriate approach will lead students to develop creativity in thinking and reasoning (Jawad & Majeed, 2021, pp. 175-176).

Creative thinking has several aspects that become benchmarks for assessment and become its characteristics as follows:

Table 1. Indicators of Creative Thinking

No	Measured Aspects	Indicator
1.	Fluency	- Able to give many questions about a problem - Able to provide more than one idea and solution - Able to narrate ideas and solutions fluently and straightforwardly - Provide various kinds of interpretations of a pattern, story or problem
2.	Flexibility	- Apply concepts in many different ways - Provide different solutions from most people - When discussing having different views from the majority - The direction of thinking that changes spontaneously
3.	Novelty	- Memberikan masalah yang *out of the box* - finding new ways through existing old ways - Able to find a new approach - Synthesize rather than analyze - Finding a different solution than usual
4.	Elaboration	- Details every step of the solution - Develop existing solutions - Test every detail - High beauty rating rate - Ability to add intricate details to each section

(Harisuddin, 2019, pp. 17-18)

Through creative thinking indicators, determining the appropriate approach must be considered to achieve these indicators optimally. Related to this, the characteristics of the inductive-deductive approach are one of the appropriate approaches for creative thinking skills.

Motivation to Learn

Motivation is an important thing as a support for learning activities so that they run optimally (Nurmuiza et al., 2015; 113-114), so learning motivation can be interpreted as an encouragement for students to participate in learning so that activities that are being carried out are optimal. Motivation in the learning process is needed because optimal learning outcomes are associated with active, creative, innovative, effective and fun learning. All of that can be achieved if you have a builder or driving tool as a student's strength in learning.

Motivation is the driving force needed for learning achievement to be carried out (Wijayanti, 2021; 3-4); therefore, appropriate indicators are needed to measure student motivation properly. Indicators in learning motivation have distinctive characteristics, including (1) Having hoped for ideals; (2) Rewards in learning; (3) the will to succeed is high; (4) interesting and challenging learning activities; (5) It is not easy to give up in finding solutions (Abramovich et al., 2023; 8-9).

Indicators of achievement in learning motivation can be integrated into the Inductive-deductive approach and the ability to think with creativity because, with the learning process finding conclusions from the examples given, then integrating them into other examples that align with these conclusions requires high creative thinking skills. The ability to think creatively can be carried out optimally if it aligns with high student learning motivation.

B. RESEARCH METHODS

The method used in this research is quasi-experimental (quasi-experimental), while the design used is a pretest-posttest non-equivalent group design. The groups that are formed are two groups that are selected based on the characteristics of students who are not much different. The two groups will initially be given a pretest to see their initial abilities and then will be given different treatment from the two groups. After the complete treatment is given, it will be followed by giving a posttest to see the final learning outcomes. The two groups that have been selected will be given different treatments, namely, learning with an inductive-deductive approach and learning with a conventional approach.

Experiments designed according to the pretest-posttest non-equivalent group design are as follows:

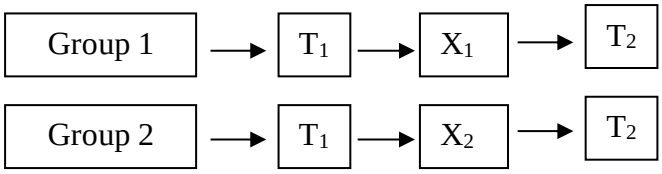

Figure1. Pretest-posttest non-equivalent group design

Information:
T_1: Inductive-deductive and conventional approach group pretest
T_2: Posttest inductive-deductive and conventional approaches group
X_1: Application of the inductive-deductive approach
X_2: Application of the conventional approach

The initial step taken in this study was to randomly select two class groups and then determine the first and second groups. After the group is selected, each group is given a pretest simultaneously. Furthermore, the researcher treated each group; the first group was given treatment in the form of learning with an inductive-deductive approach, and the second group was given treatment with a conventional approach. The post-test was given almost the same time after the treatment in each group had been completed. This activity aims to determine students' creative thinking skills and learning motivation.

The population of this research is class X students of SMA N 1 Stabat, which consists of 6 classes, each containing 35 students. The sample was selected using a simple random sampling technique from 6 classes, and two classes were obtained, namely class X-1, which was given the inductive-deductive approach treatment and X-2, which was given the conventional approach treatment. The variables in this study consist of independent variables and dependent variables. The independent variable consists of the inductive-deductive approach (X_1) and the conventional approach (X_2), while the dependent variable consists of creative thinking skills and learning motivation.

Data collection techniques were carried out through administering tests and questionnaires where the tests given were pretest and post-test. Meanwhile, the instruments used were creative thinking ability test instruments and learning motivation questionnaires. The test instruments and questionnaires that have been prepared are then validated by experts, and the results are suitable for use. In addition to validity through experts, this instrument is also validated constructively. Based on the factor analysis results, the compiled instruments were declared valid. In addition to validity, the instrument's reliability was also seen, and the result was 0.734 for the pretest of creative thinking skills with a Standard Error Measurement (SEM) of 7.71. Meanwhile, the results of the post-test of creative thinking skills were 0.763, with an SEM of 7.83. The reliability of the learning motivation questionnaire obtained results of 0.846 with an SEM of 6.78.

One sample t-test was conducted to see the effectiveness of learning with inductive-deductive and conventional approaches to each variable of creative thinking ability and learning motivation. The standard provisions for the variable ability to think creatively are if the final test exceeds the initial score and the KKM score for mathematics at the school, which equals 70. Learning is said to be effective. At the same time, the learning motivation variable is said to be effective if it reaches the high category, which is more than 102. The effectiveness of each learning on creative thinking abilities and student learning motivation is tested by hypothesis by setting the 1st class as an inductive-deductive class and the 2nd class as a conventional class, the 1st variable is creative thinking, and the second variable is learning motivation.

To see whether the inductive-deductive and conventional approaches are effective on creative thinking skills, get an average score of more than 70 on the final test. The hypothesis can be written statistically.

$$H_{01}: \mu_{1i} \leq 70, i = 1,2$$
$$H_{11}: \mu_{1i} > 70, i = 1,2 \quad (1)$$

μ_{11} is the average creative thinking in the inductive-deductive approach, and μ_{12} is the average creative thinking in conventional learning.

To see whether the inductive-deductive and conventional approaches are effective on learning motivation, get an average score of more than 102. The hypothesis can be written statistically

$$H_{02}: \mu_{2i} \leq 102, i = 1,2$$
$$H_{12}: \mu_{2i} > 102, i = 1,2 \quad (2)$$

Where μ_{21} is the average learning motivation in the inductive-deductive approach, and μ_{22} is the average motivation in conventional learning. The statistic used in testing the hypothesis is the one-sample t-test with the following formula:

$$t_{count} = \frac{\bar{x} - \mu_0}{\frac{S}{\sqrt{n}}} \quad (3)$$

Information:
$\bar{x}$ = Average Value
μ_0= Hypothesis Value
S = standard Deviation
n = Sample
H_0 rejected if $t_{hitung} > t_{tabel}$

The effect of the inductive-deductive approach on creative thinking skills and learning motivation was investigated through a compare means test using a paired sample t-test. The formula used in this test is,

$$t_{count} = \frac{\bar{X}_D}{\sqrt{\frac{\sum d^2}{N(N-1)}}} \quad (4)$$

Information:
$\bar{X}_D$ = Difference in the average of group 1 and group 2
$d = D - \bar{X}_D$
$D =$ x_1 and x_2 are paired observations from populations 1 and 2
N = Sample

The hypothesis used is that when the t_{count} results are greater than the t_{table}, it can be said that the inductive-deductive learning approach influences the ability to think creatively and learn motivation.

C. RESULT AND DISCUSSION

Description of Creative Thinking Ability

The results describe the pretest and post-test data for creative thinking and learning motivation. The data is collected before and after treatment. The description of the pretest and post-test data for creative thinking skills can be seen in Table 2 and Table 3.

Table 2. Creative Thinking Data on Pretest

Description	Class	
	Deductive-Inductive	Conventional
Average	55.292	55.752
Variance	147.368	152.371
S. deviation	12.139	12.344
Min Value	20.00	25.00
Max Value	76.00	79.00

Table 3. Creative Thinking Data on Posttest

Description	Class	
	Deductive-Inductive	Conventional
Average	74.363	68.999
Variance	152.523	48.639
S. deviation	12.350	6.974
Min Value	50.00	50.00
Max Value	92.00	80.00

Table 2 shows the average pretest score for creative thinking abilities in the deductive-inductive class of 55.292 and the average deductive-inductive abilities in the conventional class of 55.752. The lowest score is 20 in the deductive-inductive class, and the highest is 79 in the conventional class. Table 3 shows the post-test average score for creative thinking ability in the deductive-inductive class of 74.363, and the average

deductive-inductive ability in the conventional class is 68.99. The lowest score is 50 in the deductive-inductive and conventional classes, and the highest is 92 in the deductive-inductive class.

The data description shows increased average pretest and post-test data on creative thinking skills. It can also be seen that there is an increase in the minimum and maximum scores of both classes. Indicates that the treatment given before the post-test impacted increasing the value. For learning motivation, data were collected before treatment and after treatment. The description of the data on learning motivation before and after treatment can be seen in Table 4 and Table 5.

Table 4. Data on Learning Motivation Before Treatment

Description	Class	
	Deductive-Inductive	Conventional
Average	100.429	97.20
Variance	572.311	427,871
S. deviation	23.923	20.685
Min Value	50	50
Max Value	112	97

Table 5. Data on Learning Motivation After Treatment

Description	Class	
	Deductive-Inductive	Conventional
Average	127.743	98.771
Variance	204.079	413.24
S. deviation	14.286	20.328
Min Value	100	45
Max Value	150	138

Table 4 shows the average value of learning motivation in the deductive-inductive class before treatment of 100.429, and the average learning motivation in the conventional class is 97.20. The lowest score was 30 in both classes, and the highest was 112 in the deductive-inductive class. Table 5 shows the average value of learning motivation in the deductive-inductive class after treatment of 127.743, and the average learning motivation in the conventional class is 98.771. The lowest score is 45 in the conventional class, and the highest is 150 in the deductive-inductive class.

Through the description of the data, it can be seen that the average increase in motivation to learn before and after being given treatment. It can also be seen that there is an increase in the minimum and maximum scores of both classes. Indicates that the treatment given before treatment impacts increasing the value.

Normality Test

The normality test obtained from the inductive-deductive class before treatment was 0.189 for creative thinking and 0.360 for learning motivation. While the inductive-deductive class after treatment was 0.067 for creative thinking and 0.216 for learning motivation. The conventional class has a normality test of 0.070 for creative thinking skills and 0.565 for learning motivation. These results indicate that the value obtained is more than 0.05, so it can be concluded that the two classes are normally distributed.

Homogeneity Test

After the normality results are obtained, proceed with looking for homogeneity results of statistical aplication with SPSS. For homogeneity test results can be seen from Table 6.

Table 6. Homogeneity Test Results

Information	Before Treatment	After Treatment
Box's M	7.502	9.929
F	0.691	1.012
Sig	0.407	0.679

Based on Table 6, the results for significant values before and after being given treatment were 0.407 and 0.679, where these values were greater than 0.05; in other words, the data on creative thinking ability and learning motivation before and after treatment fulfilled the homogeneity assumption.

One Sample t-test

Learning is tested to see its effectiveness through a one-sample t_{count}, with the determination of criteria if $t_{count} > t_{table}$, then the learning carried out is concluded to be effective for each of the specified variables. The results of this test calculation can be seen in Table 7.

Table 7. One Sample t-Test Results

Variants	Class	t_{count}	t_{table}	Information
Creative thinking	Deductive-Inductive	2.090	1.684	Effective
	Conventional	-0.849	1.684	Not Effective
Motivation of learning	Deductive-Inductive	10.661	1.684	Effective
	Conventional	-0.940	1.684	Not Effective

Based on Table 7, the t_{count} results were 2.090 and 10.661 for creative thinking and learning motivation variables in the inductive-deductive class. Whereas for the conventional class, the t_{count} results were -0.848 and -0.940 for inductive-deductive variables and learning motivation. The t_{table} value obtained for each variable is 1.684, so it can be concluded that the deductive-inductive class is effective on creative thinking abilities and learning motivation. The result can be seen from the t_{count} value greater than the t_{table}. Conventional classes are ineffective on inductive-deductive abilities and learning motivation seen from the t_{count} value smaller than the t_{table}.

Paired Sample t-Test

Learning was tested to see the effect of the inductive approach on the ability to think creatively and motivation to learn through a one-paired sample t-test, with the determination of criteria if $t_{count} > t_{tabel}$, then the learning carried out was concluded to affect each of the specified variables. The results of this test calculation can be seen in Table 8.

Table 8. Paired Sample t-Test Results

Variants	t_{count}	t_{table}	Sig. (2-tailed)	Sig.
Creative thinking	6.149	1.960	0.00	0.483
Motivation of learning	6.344	1.960	0.00	0.283

Based on Table 8, the t_{count} results are 6.149 and 6.344 for creative thinking and learning motivation variables in the inductive-deductive class. The t_{table} value obtained for each variable is 1.960, so it can be concluded that the deductive-inductive approach effectively influences creative thinking abilities and learning motivation.

D. CONCLUSION AND SUGGESTIONS

Based on a review of previous data, implementing learning using a deductive-inductive approach is effective for students' creative thinking abilities and learning motivation. This is proven by researchers as model teachers who provide direct learning. This study used an experimental and a control class and the classes were given a pretest to determine students' initial abilities before treatment. The experimental class was given a learning treatment with a deductive-inductive approach and the control class was given a conventional learning treatment then each class was given a posttest to see whether or not there was an effect of the treatment given. After conducting the research, it turned out that the experimental class which was given treatment with the deductive-inductive approach had an effect with t_{count} of 2,090 and 10,661 for students' creative thinking abilities and student learning motivation. the t_{table} value was 1,960, it can be concluded that the class that was treated with the deductive-inductive approach influenced creative thinking abilities and learning motivation.

This is none other than because the deductive-inductive approach can provide new experiences to students in solving mathematical problems by using their creative thinking abilities. This can motivate learning as has been proven by several previous researchers. This research can also allow teachers to develop the best lesson plan, implement it with the best approach, and influence other math skills. The limitation of this study is that the abilities measured through the deductive-inductive approach are only limited to the ability to think creatively. Suggestions for future researchers are to be able to look for the effect of the deductive-inductive approach on other mathematical abilities.

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