Improving students’ mathematical intuitive thinking ability using analogy learning model

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Abstract. Analogy learning model is a learning that use analogies, namely comparing concept target and concept analog to find related features both of them then make conclusion. The purpose of this research was to know students’ mathematical intuitive thinking ability between students taught with Teaching with analogy model and those taught using a scientific learning. The research was conducted at senior high school in Depok. The method of research used quasi experiment method with posttest-only control group design. The samples are 71 students, they are 37 students in experimental group and 34 students in control group by cluster random sampling technique. Data collection to measure the ability of students’ mathematical intuitive thinking used by test instrument. The result of this research shows that the value of $\text{sig.}=0.000$ less than signification standard $0.05$ on hypothesis test. This indicates that the average of students’ mathematical intuitive thinking ability on teaching sequences and series taught using teaching with analogy model is higher than those taught with scientific learning. This research concludes that learning mathematics using teaching with analogy model has an effect on students’ mathematical intuitive thinking ability.

1. Introduction
Learning mathematics at school is inseparable from solving mathematical problems or problems. By learning mathematics, students are expected to have honed their thinking skills because they are accustomed to solving problems in mathematics so that they can be applied to problems that occur in everyday life. Solving mathematical problems requires many solutions in order to obtain the desired results, one of which is intuitive thinking [1]. Mathematical intuitive thinking ability is a person's ability to understand and at the same time find the right and quick strategy in solving problems spontaneously, immediately, global or maybe suddenly and it is not known where it came from [2]. Intuitive thinking is here to help bridge the missing information between one another. Thoughts that arise spontaneously or suddenly are the only hope for a problem to be solved.

Dreyfus T. & Eisenberg T say that intuitive understanding is needed as a "thinking bridge" when someone tries to solve problems and guides aligning initial conditions and goal conditions [2]. This opinion is also in line with Fischbein's opinion in Munir that intuitive abilities can be used as intermediate cognition or mediating cognitive that can be used as a bridge for one's understanding so that it can help and facilitate in determining the strategies that must be done to reach a solution [3]. In other words, intuitive ability plays an important role when someone experiences a deadlock in finding a solution to a problem by connecting various information or experiences that they already have.

Prastowo stated that the ability of students to answer questions that require high thinking skills is still low [4]. This is reinforced by the results of the 2015 Program for International Student Assessment (PISA) test, Indonesia scored 386 with an average of 490. At levels 5-6, Indonesian
students scored 0.8 out of an average of 15.3 [5]. Intuitive thinking skills can be categorized at levels 5-6 in PISA, namely students are able to process and work with models in complex situations and make assumptions and are able to think and reason with mathematics [6]. This is in accordance with one of the properties of intuition, namely extrapolativeness which means predicting, guessing, estimating [7]. Thus, students' intuitive thinking ability is still relatively low.

Based on the results of research conducted by Rini at one of the senior high schools in South Tangerang in 2016 showed that intuitive thinking skills were still relatively low, reaching an average value of 59.30. The achievement of intuitive thinking skills includes indicators of the ability to solve problems quickly in a reasonable manner, the ability to solve problems quickly using a combination of formulas and algorithms owned, the ability to solve problems quickly based on generalizing examples or concepts with an average value of each indicator is 56 .05, 52.34, 66.02 [7]. Reinforced by preliminary research conducted by researchers in senior high school. The researcher proposed an intuitive thinking ability instrument to 35 students. The results obtained are the average mathematical intuitive thinking ability of students is still relatively low, with a percentage of 37%.

Fischbein argues that through the process of training, one can develop new intuitions. Thus this view implies that intuition can be learned, acquired, and developed [8]. The training process carried out must be optimal so that students' intuition can develop properly. The training process can also be supported by the learning process in the classroom by actively involving students. Students can build their own knowledge and experience and bring out their intuition.

The results of the author's observations, it was found that learning in schools tends to be still teacher centered. The teacher still explains the material in full without actively involving students. Learning in the classroom also lacks linking one material to another, so students cannot build their own knowledge. This causes students' intuitive thinking skills do not develop. In order to realize students' mathematical intuitive thinking skills to develop and improve, the learning process carried out must involve students actively building their own understanding and bringing up their intuition. This is in accordance with the notion of intuition according to Fischbein in terms of its nature and form, namely intuition is used to anticipate in initiating activities and a global perspective [3]. Based on these properties, it can be said that intuition inspires and directs in determining the steps to construct and find a solution to the problem. In line with this, the application of the analogy learning model is highly recommended.

Analogy learning model is a learning that uses analogies. Analogy is the process of drawing temporary conclusions by comparing the similarity of the process between a known concept and an unknown concept [9]. So students can solve new problems by using pre-existing knowledge by looking for similarities between the two problems. Students can find formulas independently or generalize based on the two problems being analogous. Thus, students construct their own knowledge. For example, the concept of multiplication which is seen as repeated addition is modeled similarly to addition, for example by combining several sets that have the same number of elements. [3].

Based on the background of the problem and the theoretical basis described above, the authors formulate the problem as follows:
1. How is the mathematical intuitive thinking ability of students who are taught with the Analogy Learning Model?
2. How is the mathematical intuitive thinking ability of students taught with Scientific Learning?
3. Is the mathematical intuitive thinking ability of students taught with the Analogy Learning Model higher than those taught with Scientific Learning?

2. Method
This research was conducted at Senior High School 5 Depok. The method used in this research is quasi-experiment. The research design used in this study was a Randomized Post-Test Only Control Design. The form of the research design is presented in Table 1 as follows [9,10].
Table 1. Research design.

| Group     | Treatment | Post-Test |
|-----------|-----------|-----------|
| Experimental | X_E       | Y         |
| Control   | X_K       | Y         |

The population in this study is the target population and the affordable population. The target population in this study were all students at Senior High School 5 Depok. The affordable population is all students of class XI. The sample in this study came from an affordable population by taking samples from all class XI with cluster random sampling technique. Samples will be randomly selected from two classes which will be the experimental group and the control group. The experimental group is the class with the analogy learning model treatment, while the control group is the class with the scientific learning treatment.

The data generated in this study is the score data of students' mathematical intuitive thinking skills. The instrument used in this study was a written test in the form of a description question. The test was made to measure students' mathematical intuitive thinking skills which consisted of 5 essay questions on the subject of mathematical induction. The test questions for mathematical intuitive thinking skills are given according to indicators, namely the ability to solve problems quickly in a reasonable manner, the ability to solve problems quickly using a combination of formulas and algorithms owned, and the ability to solve problems quickly and use generalizations based on their knowledge and experience. Before use, the instrument must be tested with several tests as follows.

2.1 Validity Test
Test the validity using the product moment correlation formula as follows [11].

\[ r_{hitung} = \frac{N \sum XY - (\sum X)(\sum Y)}{\sqrt{(N \sum X^2 - (\sum X)^2)(N \sum Y^2 - (\sum Y)^2)}} \]

Notes:
- \( r_{hitung} \) correlation coefficient between variables X and Y, two correlated variables
- Criteria for testing the validity of the questions by comparing the results of \( r_{count} \) dan \( r_{table} \) at the level of significance 5% (\( \alpha = 0.05 \)). The question is said to be valid if \( r_{count} \geq r_{table} \). On the other hand, the question is said to be invalid if the value of \( r_{count} < r_{table} \). Based on the results of the calculation of the validity of the method mentioned above, from the 5 questions obtained 4 valid items and 1 invalid item, namely item number 3.

2.2 Reliability Test
Reliability test is a test to determine the level of confidence of the instrument to be tested. The reliability used is the Alpha formula as follows [11].

\[ r_{\alpha} = \left( \frac{k}{k-1} \right) \left( 1 - \frac{\sigma^2}{\sigma_{k-1}^2} \right) \]

Notes:
- \( k \) = lots of valid questions
- \( \sigma^2 \) = total variance
- Based on the calculation of the previous validity test, it was concluded that the valid items in this study were items number 1, 2, 4, and 5. Item number 3 was not valid in the validity test so that only 4 items were tested in the reliability test and from The reliability test results obtained 0.587 which means that the degree of reliability is moderate.

2.3 Difficulty Level Test
The test item difficulty level is an indicator that shows the quality of the item [11]. To calculate the level of difficulty using the following formula [12].
4

\[ P = \frac{B}{JS} \]

Notes:
P = difficulty index
B = the number of test-taking student scores on certain items
JS = the maximum number of scores of all test-taking students

The results of the calculation of the difficulty level on the mathematical intuitive thinking ability test instrument found that questions number 1, 4, and 5 were in the medium category, number 2 was in the easy category, and number 3 was in the difficult category.

2.4 Discriminatory Test

The formula for determining the difference power index is as follows [12].

\[ D = \frac{B_A - B_B}{J_A - J_B} \]

Notes:
\( J_A \) = the number of students in the upper group
\( J_B \) = the number of students in the lower group
\( B_A \) = the number of students in the upper group who answered the question correctly
\( B_B \) = the number of students in the lower group who answered the question correctly

The results of the calculation of the discriminating power test on the mathematical intuitive thinking ability test instrument were found that the discriminatory power of the questions was included in the sufficient category. This research is a quantitative research, with a systematic calculation because it relates to the value in the form of numbers (post-test results). The effect of the Learning Model by Analogy on students' mathematical intuitive thinking skills can be measured using the t-test, because the two samples have different members. The prerequisite tests needed are normality tests and homogeneity tests.

2.5 Normality Test

The normality test aims to test whether the distribution of the selected sample comes from a normal or abnormal population distribution [13]. If the data is normally distributed, then the t-test is used to test the similarity of the two averages. However, if the data is not normally distributed, then the hypothesis testing uses a non-parametric test.

There are many kinds of normality tests, but the one used in this study is the Shapiro-Wilk test contained in the SPSS (Statistical Product and Service Solution) software with the following hypothesis formulation.

If \( \chi^2_{hitung} < \chi^2_{table} \) then \( H_0 \) accepted
If \( \chi^2_{hitung} \geq \chi^2_{table} \) then \( H_0 \) rejected

2.6 Homogenitas Test

The homogeneity test is used to determine whether the selected sample has the same variation or diversity of values or is statistically the same. Data homogeneity is one of the recommended requirements to be tested statistically, especially when using parametric test statistics, such as t-test and F-test [13]. The calculation of the homogeneity test in this study used SPSS (Statistical Product and Service Solution) software. The Statistical hypothesis

\[ H_0: \sigma_1^2 = \sigma_2^2 \]
\[ H_1: \sigma_1^2 \neq \sigma_2^2 \]
2.7 Hypothesis Test
If the analysis requirements test has been carried out, the next step is to calculate the statistical hypothesis test using SPSS software. If the results from the analysis prerequisite test show that the data is normally distributed and homogeneous, then this study uses the Independent Sample T Test analysis, whereas if the results of the test prerequisite analysis shows that the data is not normally distributed but normally distributed or not homogeneous, so this study uses the Mann-Whitney test analysis. The statistical hypothesis proposed in this study is as follows.

\[ H_0: \mu_1 = \mu_2 \]
\[ H_1: \mu_1 > \mu_2 \]

Note:
\( \mu_1 \): the average mathematical intuitive thinking ability of students in the experimental class
\( \mu_2 \): the average mathematical intuitive thinking ability of students in the control class

3. Results
3.1. Result
This research was conducted at Senior High School 5 Depok. This research was conducted in XI class, namely XI Science class as the experimental class with 37 students and class the control class with 34 students. Experimental class was given the treatment of mathematics learning with the Analogy Learning Model and control class was given the treatment with Scientific Learning.

This research was conducted on the subject matter of mathematical induction which was delivered in seven meetings. At the end of the meeting, both classes were given a post-test in the form of a mathematical intuitive thinking ability test. The test instrument consists of 5 description questions which are arranged according to the indicators of mathematical intuitive thinking ability to be measured. The test instrument given to both classes has passed the instrument's feasibility test. After the test instrument for the mathematical intuitive thinking ability is given, the post-test result data is then processed so that it can provide an overview of the students' mathematical intuitive thinking ability. The mathematical intuitive thinking ability studied in this study is based on three indicators, namely the ability to solve problems quickly in a reasonable manner, the ability to solve problems quickly using a combination of formulas and algorithms owned, and the ability to solve problems quickly using generalizations based on knowledge and experience owned.

The comparison of the results of the students' mathematical intuitive thinking ability test results between the experimental class taught by the analogy learning model and the control class taught by scientific learning can be seen in Table 2 as follows.

Table 2. Descriptive statistics of students' mathematical intuitive thinking ability experimental class and control class.

|          | N  | Range | Min  | Max  | Mean | Std. Dev. | Skewness |
|----------|----|-------|------|------|------|-----------|----------|
| Experimental | 37 | 62.50 | 31.25| 93.75| 66.0473| 14.54911  | -.377    |
| Control   | 34 | 62.50 | 25.00| 87.50| 49.6324| 15.45867  | .710     |
| Valid N   | 34 |       |      |      |       |           |          |

Table 2 shows that the average value of the experimental class is higher than the control class with an average value of 66.04 in the experimental class and 49.63 in the control class. The maximum student score is in the experimental class, which is 93.75, while the minimum score is in the control class, which is 25.00. The standard deviation of the experimental class is lower than the control class. This shows that the students' mathematical intuitive thinking ability in the control class is more diverse than the experimental class. When viewed from the level of slope (skewness), the experimental class...
has a negative value, which means that most of the experimental class data is above the average. The slope level of the control class is positive, which means that the control class data is below the average.

Figure 1. Comparison of data frequency distribution of values experimental class and control class.

Figure 1 shows that there are differences in the distribution of data between the experimental class students and the control class. The experimental class curve is more inclined to the right or larger while the control class curve tends to the left or the value is smaller. This shows that the highest value is obtained by the experimental class and the lowest value is obtained by the control class. Comparison of the value of mathematical intuitive thinking ability of experimental class and control class students has a significant difference in the number of students who score between 70 to 90. Scores in this interval are more dominated by experimental class students with more student frequencies than the control class.

3.1.1 Intuitive mathematical thinking ability of experimental class and control class students reviewed based on indicators

Students’ mathematical intuitive thinking ability were analyzed more sharply in terms of indicators, namely the ability to answer questions quickly in a reasonable manner, the ability to answer questions quickly using a combination of formulas and algorithms owned and the ability to answer questions quickly based on generalizations from examples or concepts. The average mathematical intuitive thinking ability in the experimental class and control class is reviewed based on the indicators presented in Table 3 as follows.

| No. | Indicator                                                                 | Experiment | Control |
|-----|---------------------------------------------------------------------------|------------|---------|
| 1.  | Ability to solve problems quickly sensibly                               | 63,51      | 49,26   |
| 2.  | Ability to solve problems quickly using a combination of formulas and algorithms owned Ability to solve problems quickly using generalizations based on knowledge and experience | 67,56      | 46,32   |
| 3.  |                                                                             | 69,59      | 53,67   |
Based on Table 3 on the indicators of the ability to solve problems quickly and sensibly, the achievement of the experimental class is superior to that of the control class. In the indicator of the ability to solve problems quickly using a combination of formulas and algorithms, the experimental class's achievement is far superior to the control class. Furthermore, on the indicator of the ability to solve problems quickly based on generalizations based on the knowledge and experience possessed, the achievement of the experimental class is superior to that of the control class. Judging from the three indicators, the experimental class is always superior to the control class in every indicator of intuitive mathematical thinking ability.

This study uses quantitative analysis, which is an analytical technique whose analysis process is carried out by mathematical calculations. The data that has been collected is processed and analyzed to answer the problem formulation and research hypotheses. The data processing process starts from the normality test to the difference test of the two class averages. The research is carried out using SPSS software. Before testing the hypothesis, the analysis prerequisite test is carried out, namely the normality test and homogeneity test first. The following is the calculation of the normality test and homogeneity test. After testing the analytical prerequisites which resulted in the conclusion that the data were normally distributed and had homogeneous variance, then the hypothesis test would be carried out with a t-test. The calculated data are presented in Table 4 below.

| Table 4. The result of the difference in the average score of students intuitive mathematical thinking ability of the experimental class and control class. |
|-----------------------------------------------|
| Levene's Test for Equality of Variances | t-test for Equality of Means |
| F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
|---|------|---|----|----------------|----------------|---------------------|
| Equal variances assumed | .062 | .966 | 4.609 | .000 | 16.41494 | 3.56139 |
| Equal variances not assumed | 4.597 | 67.557 | .000 | 16.41494 | 3.57065 |

Based on Table 4, it can be seen that the results of the similarity test of the experimental and control class averages show the value of $t = 4.609$ and sig. (2-tailed) = 0.000. The two-way significance value of this study is 0.000 < 0.05. This shows the rejection of $H_0$ and the acceptance of $H_1$. $H_1$ stating that the average mathematical intuitive thinking ability of the experimental class taught with the analogy learning model is higher than the average mathematical intuitive thinking ability of the control class taught with scientific learning.

4. Discussion

4.1. Analysis of mathematical intuitive thinking ability test results

The description that the researcher in the previous discussion shows that the difference in treatment in terms of learning given to the experimental class and the control class causes differences in students' mathematical intuitive thinking abilities. In the experimental class, the Analogy Learning Model was applied which in every step of learning made students' mathematical intuitive thinking skills develop better than the control class which was applied to Scientific Learning. The average test result for mathematical intuitive thinking skills in the experimental class is 66.04 while the average mathematical intuitive thinking ability in the control class is 49.63. After testing the hypothesis, obtained a significance value of 0.000. Therefore, it can be said that the average mathematical intuitive thinking ability of the experimental class is higher than the average of the control class.

Intuitive mathematical thinking ability this study consisted of three indicators, namely the ability to answer questions quickly in a reasonable manner, the ability to answer questions quickly using a combination of formulas and algorithms owned, and the ability to answer questions quickly based on generalizations from examples or concepts. Among the three indicators, the experimental class is superior to the control class. In order to be more detailed, the researcher describes the students' mathematical intuitive thinking ability on each indicator of the post-test results of the experimental
class and control class students. The following is an explanation of students' mathematical intuitive thinking abilities in terms of each indicator.

4.1.1. Ability to solve problems quickly and sensibly
The indicator of the ability to solve problems quickly and sensibly as measured in this study is the ability of students to predict answers and explain answers sensibly, will be shared with some of his friends. The following is an example of question number 4 which represents an indicator of the ability to solve problems quickly and sensibly.

Last week, Tika and her family went on vacation to Malang. While in Malang, Tika visited many tourist attractions, one of which was an apple orchard. There, he bought a pack of $13^n+6^{(n-1)}$ apples. If the apple is distributed among seven of his friends, will Tika's apple be used up or left over? Prove your answer!

Based on Figure 2, it can be seen that there are differences in the way students answer the experimental and control classes. Experimental class students were able to predict whether the apples to be divided would be used up or not, while control class students were not. Experimental class students predict the answer that the apple will be divisible and the prediction is correct. This shows that the experimental class students have used their intuitive abilities.

It can also be seen from how to prove the answer between the experimental class and the control class. Experimental class students prove the answer by using mathematical induction that the apple will run out if it is distributed among seven people. Control class students prove the answer by simply replacing the value of $n$ with some numbers. The control class student's answer is correct when the value of $n$ is replaced that apples will be divisible by, but the numbers cannot represent other numbers so the statement can be true. Therefore, the statement must be proven by mathematical induction because mathematical induction can prove a statement in general so that it can contain every number.

Based on the processing time, the experimental class students worked in 9 minutes 26 seconds while the control class students worked in 11 minutes 29 seconds. Experimental class students answered questions with faster processing time than the control class, which was under 10 minutes.

After being calculated in the experimental class, there were 5 students who worked on questions under 10 minutes, 3 of them got a perfect score, 4 points because the answers given were correct. In the control class, there were 4 students who worked on questions under 10 minutes, but only 1 person got...
a perfect score. This shows that the experimental class has better intuitive thinking skills than the control class.

The results of the post-test questions showed that the average indicator of the ability to solve problems quickly and sensibly in the experimental class was 63.51. In the control class the average indicator of the ability to solve problems quickly is reasonable at 49.26. Based on this, it can be concluded that in this indicator the experimental class is higher than the control class.

In the analogy learning model at the stage of introducing the target concept, students are trained to understand the new material given. The newly introduced material can be one of the logical reasons that students can use to solve a problem. At this stage, students' mathematical intuitive thinking skills can increase on the indicator of the ability to solve problems quickly in a reasonable manner.

4.1.2. Ability to solve problems quickly using a combination of formulas and algorithms owned

The indicator of the ability to solve problems quickly using a combination of formulas and algorithms that is measured in this study is the ability of students to use formulas and algorithms that have been previously owned and during the learning process. The item that represents this indicator is question number 2. The following is an example of question number 2 which represents an indicator of the ability to answer questions quickly and use a combination of formulas and algorithms owned.

“Dinda is a high school student in class XI who is celebrating her birthday at her house. She invited some of her friends to come to her birthday party today. If there are n people who invite Dinda to her birthday party and each person shakes hands with another person only happens once.

a. Design a formula for the number of handshakes using a series, if Dinda doesn't shake hands!
b. Based on answer a, prove it by mathematical induction”

Based on the results of the different answers of the experimental class and control class students, the experimental class students and the control class students answered question 2a correctly. This shows that students in both classes are able to understand. The experimental class students were able to use the combination of series formulas and mathematical induction correctly, while the control class students were not. So that the control class students' answers to question 2b are still not correct, while the experimental class students' answers are correct. Based on the processing time, the experimental class students answered in 11 minutes 18 seconds while the control class students answered in 15 minutes. Experimental class students answered the questions with faster processing time compared to the control class even though it was still more than 10 minutes. After being calculated in the experimental class who got a perfect score, 4 points, as many as 6 people. This shows that the student is able to answer correctly and the processing time is under 10 minutes. In the control class, only 2 students got a perfect score, 4 points. This shows that the experimental class has better intuitive thinking ability than the control class.

The results of the post-test questions showed that the average indicator of the ability to answer questions quickly using a combination of formulas and algorithms owned by the experimental class was 67.56. In the control class the average ability to solve problems quickly using a combination of formulas and algorithms is 46.32. Based on this, it can be concluded that in this indicator the experimental class is higher than the control class. In the Analogy Learning Model in the stage of repeating the analog concept, students are asked to recall the material that has been studied previously. The material on the analog concept is closely related to the target concept. Thus, students can combine the formulas contained in the target concept and the analog concept to solve a problem. After students do this stage, students' mathematical intuitive thinking skills will increase, especially on the indicators of the ability to solve problems quickly using a combination of formulas and algorithms they have.

4.1.3. Ability to solve problems quickly using generalization based on experience and knowledge

The following is an example of question number 1 which represents an indicator of solving problems quickly using generalizations based on experience and knowledge possessed.
Kevin and Deny are playing a matchstick game. They arranged it into a triangular shape. In the first triangular arrangement, two triangles are formed consisting of five matchsticks. The second arrangement consists of four triangles and consists of nine matchsticks. The third arrangement consists of six triangles and is composed of thirteen matchsticks. If they want to arrange matchsticks up to the 18th order. Define:

a. The number of triangles formed and the general formula using the sigma notation!

b. The number of matchsticks arranged and the general formula uses the sigma notation!

Based on the results of the answers, students in the experimental class and control class answered that the total of triangles and matches until the 18th term was correct. Both of them used the formula for the number of arithmetic series that they had previously learned at the junior high school level. However, when asked the general formula for the series using sigma notation, the control class students did not answer it while the experimental class students answered correctly using the generalization of the arithmetic sequence concept. Experimental class students answered by finding the general formula for the nth term of an arithmetic sequence and then writing it down using sigma notation.

Based on the processing time, the experimental class students answered in 8 minutes 38 seconds while the control class students answered in 13 minutes 57 minutes. Experimental class students answered questions with faster processing time than the control class, which was less than 10 minutes. After being calculated in the experimental class, 19 students who worked on questions under 10 minutes, 4 of them got a perfect score, 4 points because the answers given were correct. In the control class, the students who worked on the questions in less than 10 minutes and got a perfect score of 4 people. This shows that the experimental class has better intuitive thinking ability than the control class, although many students from the experimental class answered in less than 10 minutes the answer was still not correct.

The results of the post-test questions showed that the average indicator of the ability to solve problems quickly and sensibly in the experimental class was 69.59. In the control class the average indicator of the ability to answer questions quickly in a reasonable manner is 53.67. Based on this, it can be concluded that in this indicator the experimental class is higher than the control class. In the Analogy Learning Model, after students perform the stages of introducing the target concept, repeating analog concepts and mapping analogies, students make conclusions based on the generalizations of the three stages. At this stage, students are trained to generalize various kinds of ideas contained in each stage of the Analogy Learning Model so that at that stage students' mathematical intuitive thinking abilities on indicators of ability to solve problems quickly using generalizations based on experience and knowledge can increase.

Judging from the way to answer the post-test students in the experimental class and the control class students have differences. The differences in how to answer the experimental class and the control class are presented in Table 5 below.

| No | Indicator                      | Experiment Class                          | Control Class                           |
|----|--------------------------------|------------------------------------------|-----------------------------------------|
| 1  | Ability to solve problems quickly sensibly | Able to predict answers and prove using mathematical | Directly answer without predicting the answer and |

Table 5. How to answer experiment class students and control class students.
induction. prove the answer manually, which is just replacing the value of n with some numbers.

2 Ability to solve problems quickly using a combination of formulas and algorithms owned

- Able to understand a given problem and use a combination of series formulas and mathematical induction appropriately.
- Able to understand the problem given but has not been able to combine the series formula and mathematical induction so that the resulting answer is not correct.

3 Ability to solve problems quickly using generalizations based on knowledge and experience

- Able to answer the number of triangles and matches formed using series formulas that have been studied previously and able to generalize so as to be able to write general formulas using sigma notation.
- Able to answer the number of triangles and matches formed but not able to generalize to determine the general formula of triangles and matches formed.

The post-test results showed that the average of each indicator ability of the experimental class students' mathematical intuitive thinking ability was 66.04 while the control class was 49.63. With details of mathematical intuitive thinking skills can be seen in Table 6 below.

**Table 6.** Average score and runtime per indicator experiment class and control class.

| No | Indicator                                                                 | Experiment | Control |
|----|---------------------------------------------------------------------------|------------|---------|
| 1  | Ability to solve problems quickly sensibly                               | 63.51      | 49.26   |
|    | Ability to solve problems quickly using a combination of formulas and     | 67.56      | 46.32   |
|    | algorithms owned                                                         | 0:10:39    | 0:13:27 |
| 2  | Ability to solve problems quickly using generalizations based on          | 69.59      | 53.67   |
|    | knowledge and experience                                                 | 0:10:17    | 0:13:32 |

Based on Tables 5 and 6, it can be seen that the experimental class taught using the Learning Model by Analogy has more developed intuitive thinking abilities than the control class taught by Scientific Learning. This is because the learning process in the experimental class helps improve students' mathematical intuitive thinking skills. At the stage of introducing the target concept, students are trained to understand the new problem given. At this stage students are trained to understand the problem so that they are able to solve it quickly and sensibly. Two of the three indicators of intuitive mathematical thinking ability require students to recall previously studied material, namely the ability to solve problems quickly using a combination of formulas and algorithms and the ability to solve problems quickly using generalizations based on their knowledge and experience. One of the stages in the Analogy Learning Model helps students to recall the material they have learned, namely repeating the analog concept so that the experimental class students taught by the Analogy Learning Model have advantages over the control class students who are taught the Scientific Learning Model. It can be seen from the average score of the post-test results of the two indicators, the experimental class has a higher average score than the control class. This is in accordance with Calik's findings in Baiq Asma Nufida.
in the journal Analogy Bridge Models in Chemistry Learning to Help Understanding Microscopic Aspects of Students that students who are taught with the Analogy Learning Model have better recall because students have new information linking with things that has been understood so as to make it easier for new information to be transferred in long-term memory [14]. Another relevant research is a quasi-experimental research conducted by Rini. The study concluded that the Open Ended Approach can develop mathematically intuitive thinking skills. The indicators measured are the ability to solve problems quickly in a reasonable manner, the ability to solve problems quickly using a combination of formulas and algorithms owned, and the ability to solve problems quickly based on generalizations from examples or concepts [3]. These three indicators have similarities with the indicators measured in this study. From previous research, it can be concluded that students' mathematical intuitive thinking skills can be improved, one of which is by applying the Learning Model by Analogy. Another relevant research is the research of Kurniawati L et.al. [15] and Kurniawati L et.al. [16] which states that students' mathematical intuitive thinking skills can develop better through constructivism learning such as problem-based learning models and puzzle-based learning compared to conventional learning.

The average of each indicator of the experimental class's mathematical intuitive thinking ability is higher than the control class. Although the average of the control class taught with Scientific Learning is lower than the experimental class, it does not mean that this learning does not have a positive influence on the ability to think mathematically intuitively. The combination of the two can certainly be used as an alternative choice when learning mathematics to improve students' mathematical intuitive thinking skills.

5. Conclusions
Based on the results of the analysis and discussion of research on the effect of Learning Models by Analogy on mathematical intuitive thinking skills, the following conclusions are obtained.

1. The students' mathematical intuitive thinking ability in the experimental class taught with the Analogy Learning Model has an average score of 66.04. The highest indicator is the ability to solve problems quickly using generalizations based on knowledge and experience with an average value of 69.59, while the lowest indicator is the ability to solve problems quickly in a reasonable manner with an average value of 63.51.

2. The students' mathematical intuitive thinking ability in the control class taught with the Scientific Learning Model has an average score of 49.63. The highest indicator is the ability to solve problems quickly using generalizations based on knowledge and experience with an average value of 53.67 while the lowest indicator is the ability to solve problems quickly using a combination of formulas and algorithms owned with an average value of 46.32.

3. Based on the value of sig. = 0.000 which is smaller than the significance level of 0.05 in the hypothesis test, it shows that the average mathematical intuitive thinking ability of experimental class students taught by using the Analogy Learning Model is higher than the average mathematical intuitive thinking ability control class students who are taught with the Scientific Learning Model.

The researcher only controls the research subjects which include the analogy learning model variables and mathematical intuitive ability. Other variables such as interests, talents, motivation, learning environment and others are beyond the control of the researcher. The results of this study may be influenced by other variables outside the variables that have been set in this study. For further researchers who want to examine mathematical intuitive thinking skills, research should also be carried out at different levels and other mathematical materials that are adapted to the analogy learning model.
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