

Effectiveness of Treffinger Model Implementation to Improving Mathematics Learning Outcomes

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Abstract

The mathematics learning outcomes of class VII have not yet reached the Minimum Completeness Criteria (KKM) set. Learning activities have not activated students because learning is still carried out in one direction. The purpose of this study was for the pretest and post-test results of students after using the treffinger model in learning mathematics and to determine the effectiveness of the treffinger model in learning mathematics in students. The research approach used is quantitative with the type of pseudo experiment and without control. The research variables used are the treffinger model as the independent variable and mathematics learning outcomes as the dependent variable, with a population of VII grade students of SMPN 2 Enrekang in the 2018/2019 school year consisting of 4 classes, namely VIIA, VIIB, VIIC, and VIID classes so that the sample used is VIIB class with cluster random sampling technique. The data obtained were analyzed with descriptive statistics and inferential statistics. Descriptive statistics were carried out by looking at the analysis of learning outcomes with an increase in the average score from the pretest results of 46.2 to 77.4 on the posttest results, the average student activity of 88.75%, the average teacher's ability to manage the class with a score of 4.4 or with a very good category and the average student response to learning of 88%. Inferential statistics conducted with a one-sample t-test showed a significance value below $\alpha = 0.05$ so that H1 was accepted. From these data, it can be concluded that the application of treffinger learning model in class VII students of SMPN 2 Enrekang is effective.

Keywords: Effectiveness of Treffinger; Model Implementation; Learning Outcomes

Introduction

Education should provide opportunities for students to learn how to be creative in solving problems (Ndiung, Jehadus & Apsari, 2021; Ndiung, et al, 2019). Education is the learning of knowledge, skills and habits of a group of people passed down from one generation to the next through teaching, training or research. Education often occurs under the guidance of others, but it is also possible to be self-taught. The etymology of the word education itself comes from the Latin *ducere*, meaning "to lead, direct, or lead" and the prefix *e*, meaning "out". Thus, education means the activity of "leading outward". Any experience that has a formative effect on the way people think, feel, or act can be considered education. Education is generally divided into stages such as preschool, primary school, secondary school and then college, university or apprenticeship. Education is an invaluable asset to individuals and society. Education is also very important for human life. One of the basic lessons that is very important to be mastered by students starting from the elementary level to the upper level is mathematics.

Mathematics has an important role in all aspects of life. Math is one of the subjects that is not easy for most students. Mathematics is one of the fields of study that is often complained about as a difficult field of study with formulas and numbers in problem solving. Mathematics has an important role in information because the use of symbols in mathematics can prepare quality human resources characterized by the ability to obtain, manage, and utilize information in accordance with the demands of the needs.

Teachers are one of the tools to realize the expected mathematics. Teachers are educators and teachers in early childhood education through school or formal education, primary education, and secondary education. Such teachers must have some kind of formal qualification. In a broader definition, anyone who teaches something new can also be considered a teacher in the process of learning mathematics. One of the models that can be used to make students active in learning is the treffinger model.

Based on observations and interviews with students of SMPN 2 Enrekang, information was obtained that the learning outcomes of seventh grade mathematics had not reached the Minimum Completeness Criteria (KKM) set at 70. Therefore, there is still a need for improvement in the next material in an effort to improve mathematics learning outcomes. This model can fulfill the development of students' mathematical creative thinking skills (Dimyati, 2009). This treffinger model is expected to develop students' creativity in solving problems, direct students to think logically about the relationship between concepts and situations in problems and appreciate the diversity of thinking that arises during the problem solving process (Hidayati, Nandini & Adnan, 2021).

The above was done to determine the effectiveness of the application of the treffinger model on mathematics learning outcomes in Class VII Students of SMPN 2 Enrekang. For students, this research is expected to help and facilitate students in understanding mathematical materials, and be more active, especially in solving a creative problem, which will then improve student learning outcomes (Arikunto & Cepi, 2007; Juniantari, 2017).

Meanwhile, teachers can develop creativity in teaching, as input to improve their performance and professionalism (Dahar, 2011; Huda, 2013). For schools, it can be a contribution to improving the quality of education and for researchers it is hoped that it will become a learning medium as an effort to train themselves in stating, compiling, applying thoughts in writing and systematically to what has been obtained during lectures. In addition, it can also add insight to researchers about effective learning, so that in the future they can choose a better learning model (Sudarma, 2022).

The research approach used is quantitative research with a type of pseudo-experimental research without control. There are two variables, namely the treffinger model as the independent variable and math learning outcomes as the dependent variable. The population used was class VII students of SMPN 2 Enrekang in the 2018/2019 school year consisting of 4 classes, namely class VIIA, VIIB, VIIC, and VIID so that the sample used was class VIIB with cluster random sampling technique. The data obtained were analyzed with descriptive statistics and inferential statistics. Descriptive statistics were carried out to see the improvement in learning outcomes by comparing the average pretest results and the average posttest results. Inferential statistics were carried out with a one-sample t-test with the decision-making criterion being H_0 rejected if the significant level of $p < \alpha$ with $\alpha = 0.05$.

Method

This study used a quantitative approach with a type of pseudo-experiment without a control class with a total of VII classes at SMPN 2 Enrekang in the 2018/2019 school year as many as 4 classes. By cluster random sampling, the selected class was class VIIB. The class selected as the object of research was given classical learning using a predetermined learning model and in accordance with the subject matter. The instruments that will be used in this research are math learning outcomes test and observation sheet. This test is in the form of an essay and consists of 4 numbers and has gone through a validation process by experts. The data collection techniques used in this study are conducting tests, observations and questionnaires. After the data were collected, data

were analyzed with descriptive statistical analysis and inferential data analysis. Before testing the hypothesis, the data prerequisite test was first carried out, namely the data normality test and the data homogeneity test. While the research hypothesis test was carried out with a one-sample t test.

Results and Discussion

This section presents the results of the analysis based on what has been done using the Treffinger Model. The treffinger learning model was introduced by Donald J. Treffinger in 1980. This learning model consists of three levels, namely level I Basic tool, level II practice with process and level III working with real problems. This is described in two types of analysis results presented, namely the results of the analysis using descriptive statistics and the results of the analysis using inferential statistics. Descriptive statistical analysis includes descriptive results of pretest and posttest, student learning completeness, student activity, ability to manage learning, and student response. While for the purposes of inferential statistical analysis includes testing the requirements of statistical analysis including testing the requirements of analysis and hypothesis testing.

1. Descriptive Statistical Analysis

a. Description of Pretest Results

Descriptive statistics of pretest results before applying the treffinger learning model are presented in table 1.

Table 1. Pretest Results Before Applying The Treffinger Learning Model

| Statistics | Statistics Value |
|--------------------|------------------|
| Mean | 46,2 |
| Score Range | 71 |
| Mode | 56 |
| Standard Deviation | 21,9 |
| Minimum | 11 |
| Maximum | 84 |

Based on table 1, it can be concluded that the students' math learning outcomes before applying the treffinger learning model obtained an average (mean) of 46.2; mode (mode) of 56; standard deviation of (21.9), score range of 71; minimum value of 11; and maximum value of 84.

If the learning outcomes of math scores before applying the treffinger learning model are grouped into five categories, the distribution and percentage will be obtained as in table 2 below:

Table 2. Scores Before Applying The Treffinger Learning Model

| Interval | Category | Frequency | Percentage |
|------------|-----------|-----------|------------|
| 0% - 54% | Very Low | 13 | 52 |
| 55% - 64% | Low | 8 | 32 |
| 65% - 79% | Medium | 3 | 12 |
| 80% - 89% | High | 1 | 4 |
| 90% - 100% | Very High | 0 | |
| Total | | 25 | 100 |

Based on table 2 frequency distribution and percentage, it shows that students' mathematics learning outcomes before applying the treffinger learning model, there are 13 students (52%) who are in the very low category, 8 students (32%) who are in the low category, 3 students (12%) who are in the medium category, 1 student (4%) is in the high category, and no students are in the very high category.

Based on Table 1 and Table 2, it is obtained that the average mathematics learning outcomes of students before applying the treffinger learning model was 46.2 and there were no students in the very high category, even 13 students (52%) who were in the very low category and the percentage of completeness was 12%. This means that the mathematics learning outcomes of VII grade students of SMPN 2 Enrekang before applying the treffinger learning model are in the "very low" category.

b. Descriptive Posttest Results

Descriptive statistics of posttest results or before applying the treffinger learning model are presented in table 3.

Table 3. Posttest Results Or Before Applying The Treffinger Learning Model

| Statistics | Statistics Value |
|--------------------|------------------|
| Mean | 77,4 |
| Score Range | 69 |
| Mode | 80 |
| Standard Deviation | 16,1 |
| Minimum | 21 |
| Maximum | 90 |

Based on table 3, it can be concluded that the student learning outcomes variable after applying the treffinger learning model, obtained an average (mean) of 77.4: mode (mode) 80; standard deviation (16.1); score range of 68; minimum value of 21; and maximum value of 90.

If the value of students' mathematics learning outcomes before applying the treffinger learning model is grouped into five categories, the distribution and percentage are obtained as in table 4. below:

Table 4. Value Of Students' Mathematics Learning Outcomes

| Interval | Category | Frequency | Percentage |
|------------|-----------|-----------|------------|
| 0% - 54% | Very Low | 2 | 8 |
| 55% - 64% | Low | 1 | 4 |
| 65% - 79% | Medium | 4 | 16 |
| 80% - 89% | High | 13 | 52 |
| 90% - 100% | Very High | 5 | 20 |
| Total | | 25 | 100 |

Based on table 4 frequency distribution and percentage, it shows that students' mathematics learning outcomes after applying the treffinger learning model, there are 2 students (8%) in the very low category, 1 student (4%) in the low category, 4 students (16%) in the medium category, 13 students (52%) in the high category, and there are 5 students (20%) in the very high category.

Based on table 3 and table 4, it is obtained that the average mathematics learning outcomes of seventh grade students of SMPN 2 Enrekang after applying the treffinger learning model is 77.84 and there are only 2 (8%) students who are in the very low category. In fact, there are 18 (72%) students in the high category and the percentage of completeness is 88%, so it can be concluded that the mathematics learning outcomes of VII grade students of SMPN 2 Enrekang after applying the treffinger learning model are in the "high" category.

c. Student Learning Completeness

The data analysis results, the description of the completeness of students' mathematics learning outcomes for the posttest is shown in table 5:

Table 5. Description of the Completeness Of Students' Mathematics Learning Outcomes

| Score Range | Category | Frequency | Percentage |
|-------------|---------------|-----------|------------|
| 0% - 69 | Not Completed | 3 | 12 |
| 70 - 100 | Completed | 22 | 88 |
| Total | | 25 | 100 |

Table 5 shows that the percentage of classical completeness is 88%, namely out of 25 students, 22 students are included in the complete category and 3 students are included in the incomplete category. Overall, the data shows the achievement of classical completeness which exceeds 85%. Based on the posttest results, it can be said that there was an achievement of classical mathematics learning completeness for students of class VIIB SMPN 2 Enrekang in the even semester 2018/2019 after going through the treffinger learning model.

d. Description of Student Activities

The types of student activities observed were activities that were in accordance with learning and activities that were not in accordance with learning. The types of activities that are appropriate are: (1) Listening / paying attention to the teacher's explanation, (2) Asking questions in the learning process, (3) Working on worksheets, (4) Providing views and thoughts on worksheets based on the clockwise direction, (5) Summarizing the material that has been learned.

To see clearly the comparison of the percentage of student activities in accordance with learning (activities 1-5) from meetings I to IV can be seen in Figure 1.

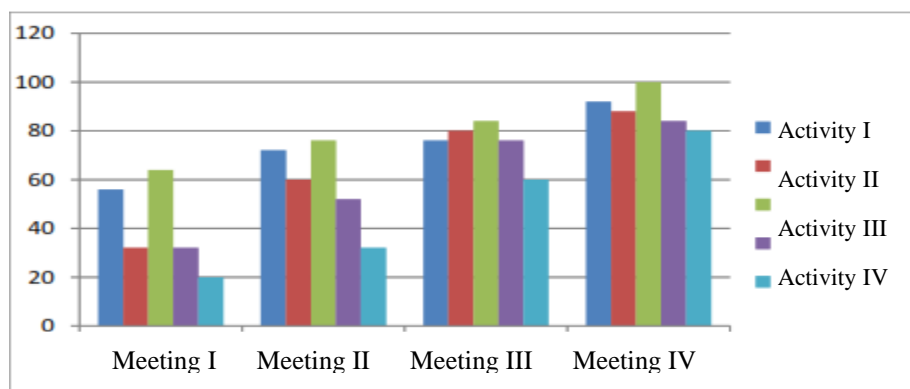


Figure 1. Comparison Diagram of the Percentage of Student Activities That Are In Accordance With Learning.

The figure above shows that in activity 1, listening / paying attention to the teacher's explanation has increased, meaning that interest in participating in the lesson has improved. Activity 2, namely asking questions in the learning process, is increasing, meaning that curiosity about the material is better. Activity 3, namely Working on worksheets, has increased towards the material and a high sense of responsibility. Activity 4, namely Providing views and thoughts on worksheets based on the clockwise direction, is increasing.

Based on the figure 1; comparison of the percentage of student activity in accordance with the above learning and analysis of student activity in appendix D.3, the average percentage value of student activity by applying the treffinger learning model is 88.25%. Thus according to the criteria for interpreting student activity in chapter III, it can be categorized as "Good".

e. Description of Teacher Activity

In this assessment, observation of teacher activities in managing learning was carried out 4 times a meeting. The description of the results of observations of teacher activities in managing learning can be seen in figure 2 below:

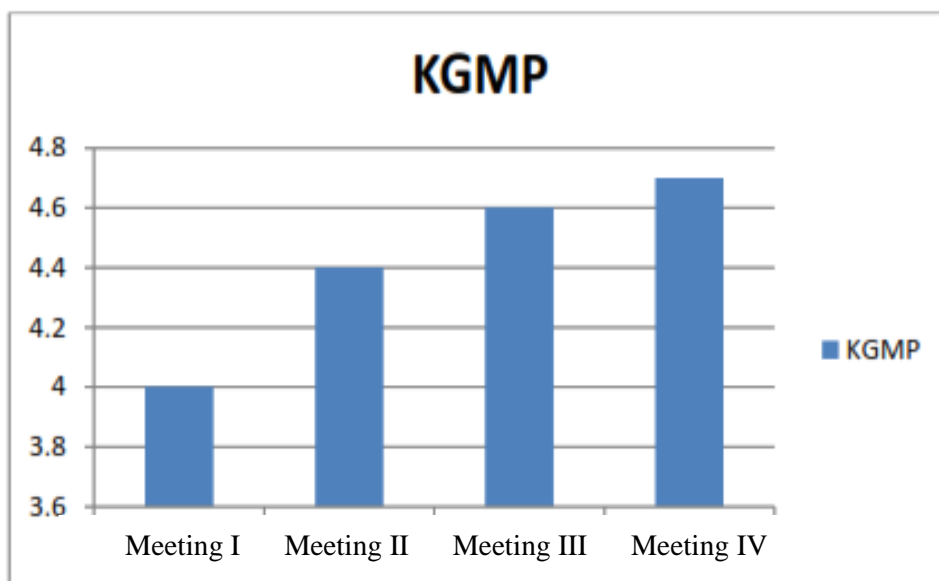


Figure 2. Comparison diagram of Teacher's Ability to Manage Learning Activities

Based on figure 2, it can be seen that the average teacher activity in managing learning is 4.40 at meeting I, 4 at meeting II, 4.4 at meeting III, 4.6 and 4.7 at meeting IV. Based on the description above, the average teacher activity in managing learning during the learning process using the treffinger learning model is 4.40. So that the teacher's activity in managing learning through the treffinger model can be said to be in the "very good" category.

f. Student Response Description

Based on the questionnaire worksheets that have been distributed to each student at the end of the meeting to obtain student responses or responses in writing, after being analyzed, it can be concluded as follows:

1) Students' opinions about math lessons

In general, students say that math is one of the most difficult subjects, and some students dislike the subject because learning math means about formulas and too many concepts or rules that they have to learn to understand the material contained in math lessons. As for those who like math, they are challenged to study harder and solve every problem in math lessons because mathematical concepts are very important in everyday life.

2) Students' opinion about treffinger learning model

most argue that the treffinger learning model is very good to be applied in the process of learning mathematics because students are given the opportunity to play an active role and students are also increasingly innovated to learn. in addition, many students find it easier to understand the teaching material they get and can solve problems well if the treffinger learning model is used in the mathematics learning process. If in treffinger learning students are required to present the results of their group work that has been obtained in solving math problems and this will be very useful for mastering the material that has been taught.

2. Inferential Statistical Analysis

Testing the basics of analysis carried out includes testing normality and homogeneity. Testing the normality and homogeneity of data on student math learning outcomes of the two tests used statistical methods with the help of SPSS version 20.0. The test was carried out on the pretest results and posttest results that had been given.

a. Normality Testing

Before hypothesis testing, the analysis requirements test was first carried out on the research data. The first requirement test is the normality test. Normality testing aims to determine whether the population is normally distributed. The test statistic carried out in the normality test is the Kolmogrov-Sminov Normality Test.

The hypothesis to be tested is as follows:

H0: Non-normally distributed population

H1: The population is normally distributed

Test criterion:

Reject H0 if the sig odds value $> \alpha$ ($\alpha = 0.05$)

Based on the results of data analysis using the Kolmogrov-Sminov Normality Test, it is known that the significance value is $0.750 > 0.05$, it can be concluded that the residual value is normally distributed, so the normality test is fulfilled.

b. Homogeneity Testing

Based on the results of population normality testing, it turns out that both experimental groups have normally distributed data, then proceed with the homogeneity test. Homogeneity testing is used to determine whether the data to be analyzed meets the constancy of variance (homogeneous), homogeneity testing can be calculated using Levene's Test for Equality of Variances.

Homogeneity testing aims to determine whether the population variance of the two populations is homogeneous (the same). Homogeneity testing can be analyzed using Levene's Test for Equality of Variances. The hypothesis tested is as follows:

H0: Population variance is not homogeneous

H1: Homogeneous variance population

Test criterion:

Reject H0 if the odds value of sig $> \alpha$ ($\alpha = 0.05$)

Based on the results of data analysis using Levene's Test for Equality of Variances, it is known that the significance value is $0.743 > 0.05$, it can be concluded that homogeneity testing is fulfilled. With this situation, hypothesis testing can be done.

c. Hypothesis Testing

The hypothesis in this study was tested using the T-test, where previously the requirements were tested. The hypothesis used is as follows:

H0 : There is no difference between the mean scores of pretest-posttest before and after the application of treffinger learning model to students of class VII SMP Negeri 2 Enrekang.

Where $\mu_B = 0$

H1: There is a difference between the mean scores of pretest-posttest before and after the application of treffinger learning model to the seventh grade students of SMP Negeri 2 Enrekang.

Where $\mu_B = 0$

Hypothesis testing criteria:

Reject the H0 hypothesis if the sig value (2- tailed) $< \alpha$ ($\alpha = 0.05$)

In learning with the Treffigger learning model is carried out with activities namely: Level I, basic tools or techniques of creativity level I includes divergent thinking skills and creative techniques. The learning activities at stage I in this study, namely: (1) the teacher gives an open problem with more than one solution, (2) the teacher guides students to conduct discussions to convey their ideas or ideas while giving an assessment to each group.

Level II, Practice with process or creativity techniques II, provides opportunities for students to apply the skills learned at level I in practical situations. For this purpose,

strategies such as role playing, simulation, and case studies are used. The learning activities at stage II in this study, namely (1) the teacher guides and directs students to discuss by providing analog or simulation examples (2) the teacher asks students to make analog or simulation examples.

Level III, Working with real problems or level III creative techniques. Applying the skills learned in the first two levels to real-world challenges. Learners use their abilities in a way that is meaningful to their lives. Learners not only learn creative thinking skills but also how to use this information in their lives. The researcher used these steps to see whether the application of the treffinger learning model was effectively applied to students of class VIIb SMP Negeri 2 Enrakang. In this section will be explained based on the results of the research analysis.

3. Descriptive Analysis Results

a. Student Learning Outcomes

The learning outcomes obtained are based on benchmark reference assessments or average criteria for minimum achievement of learning outcomes that apply at SMPN 2 Enrekang with the Minimum Completeness Criteria (KKM) that each student must achieve in mathematics subjects is 70. A class is considered to have achieved learning completeness if in that class 85% of students can achieve the Minimum Completeness Criteria (KKM).

After the research was conducted and analyzed, it was found that there was a significant difference between the pretest results and the posttest results. It can be seen that there is an average increase from 46.36 before applying the treffinger learning model to 77.84 after applying the treffinger model. The achievement of the percentage of learning completeness achieved by students who completed their learning was 88% of 25 students, this means that using the treffinger learning model is effective for students of class VIIB SMP Negeri 2 Enrakang. This is in line with the opinion of Sudjana (2001), Slameto (1980), Hamalik (2002), Mulyasa (2007).

b. Student Activity

Student activity is assessed based on a predetermined formula based on data on student activeness during the learning process. Analysis of student activity in accordance with learning from the first meeting to the fourth meeting, the average percentage value of student activity is 88.75%.

c. Teacher's ability to manage learning

The data from the observer's assessment of the teacher's ability to manage learning was analyzed by calculating the average value of each aspect observed in managing learning from each discovery.

According to the results of the assessment conducted by the observer in assessing the teacher's ability to manage learning is 4.40. So that the teacher's ability to manage learning through the treffinger model can be said to be in the "very good" category.

d. Student Response

Data on student responses to learning were analyzed by looking at the percentage of student responses. Student responses were said to be positive if the percentage of student responses in answering happy, interesting, or yes for each aspect $\geq 65\%$. If one of the aspects answered happy, interesting, or yes is not more than 65% then the student response is said to be negative.

The results of student responses regarding the treffinger learning model are that some students think that the treffinger learning model is very well applied in the mathematics learning process because students are given the opportunity to play an active role and students are also increasingly motivated to learn.

4. Results of Inferential Analysis

Data analysis techniques with inferential statistics are carried out with the aim of testing the research hypothesis. To test the hypothesis, a one-sample t-test was used with the decision-making criterion that H_0 was rejected if the significant level of $p < \alpha$ with $\alpha = 0.05$.

According to the results of inferential statistical calculations using the T-test, it also shows differences in learning outcomes between before and after applying the treffinger learning model.

Conclusion

Based on the results of the research and discussion that has been described, it can be concluded that the application of the treffinger model is effective for improving math learning outcomes in VII grade students of SMPN 2 Enrekang. This is evidenced because there is a difference between the average pretest-posttest scores before and after the application of the treffinger learning model in class VII students of SMP Negeri 2 Enrekang so that the results of hypothesis testing using the one-sample t test are H_0 rejected and H_1 accepted because the sig value (2- tailed) $< \alpha$ ($\alpha = 0.05$).

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