THE INFLUENCE OF TREFFINGER LEARNING MODELS ON MATHEMATICS COMMUNICATION SKILLS OF STUDENTS

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Abstract

This study aims to analyze the impact of the Treffinger learning model on students' mathematical communication skills. This research was conducted at Senior High School 1 Bulagi grade 10th, 2018/2019 academic year. This type of research was a Quasi-Experimental study with a Pretest-Posttest Control Group Design. Data collection on mathematical communication skills used test instruments. The results revealed that the mathematical communication skills of students taught using the Treffinger learning model were higher than those taught using the Student Team Achievement Division / STAD cooperative learning model ($F_{Count} = 5.78 > F_{table} = 4.03$). It can be seen from the results of the research that application of the Treffinger learning model has a higher effect on students' communication skills compared to the Student Learning Achievement Division (STAD) cooperative learning model. It is proven from the average mathematical communication skills of students taught with the Treffinger learning model on the written text indicator, drawing and mathematical expression expressed at 50.67 while the students taught with the Student Team Achievement Division (STAD) cooperative learning model on the written indicator text, drawing and mathematical expressions were stated at 47.50.

Keywords: Treffinger Learning Model, Mathematical Communication Ability

INTRODUCTION

Good communication skills are the basic needs of students' academic success (Khan et al., 2017; Syarifah et al., 2017; Elis et al., 2018). Students' mathematical communication skills

are different from general communication skills (Hussain, 2017; Chung et al., 2016; Nartani, Hidayat, & Sumiyati, 2015). The ability to express mathematical ideas in oral and written forms is called mathematical

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communication skills (Paruntu et al., 2018). In line with the definition of mathematical communication skills above, mathematical communication can be interpreted as the ability to express mathematical ideas both verbally, in writing, pictures, and various other visual forms (Triana et al., 2019).

Mathematical communication has an essential role in learning mathematics (Habsah, 2017; Noviyana et al., 2020; Tinungki, 2015). Through mathematical communication, students can express, explain, hear which brings students to a deep understanding of mathematics, as expressed by several experts above.

Mathematical communication is one of the skills students need (Asih, 2021; Rohid et al., 2019). The mathematical communication process may also provide students with opportunities to share ideas (Chung, Yoo, Kim, Lee, & Zeidler, 2016). Skills enable students to understand mathematics through the process of thinking, discussing, and making decisions. Skills can also guide students to show mathematical ideas in various ways (Freeman et al., 2016). Therefore, mathematical communication skills must be a prior concern in mathematics learning to foster thinking skills and convey students' ideas (Triana et al., 2019). Therefore, it is necessary to apply a learning model to guide students in improving students' mathematical communication skills. Some of the methods applied to improve students' mathematical communication skills include the Brain Base Learning Approach Using Autograph, the Realistic Mathematics Education

method (Rahman et al., 2018). Thus, students who have mathematical communication skills can bring students to a deep understanding of mathematics, as expressed by the experts above.

Mathematical communication is one of the skills students need. Skills allow students to understand mathematics through the process of thinking, discussing, and making decisions. Skills can also guide students to demonstrate mathematical ideas in various ways (Utami, 2015). Therefore, mathematical communication skills must be a major concern in learning mathematics to foster thinking skills and conveying students' ideas (Triana et al., 2019). Therefore, it is necessary to apply a learning model to guide students in improving students' mathematical communication skills. Some of the methods applied to improve students' mathematical communication skills include the Brain Base Learning Approach Using Autograph Triana, et al. (2019); Sukoco & Mahmudi (2016), the Realistic Mathematics Education method (Rahman et al., 2018). This includes the Treffinger model, which has not been carried out much research related to students' mathematical communication skills.

Because of the research background above, the researchers are interested in conducting research related to the Treffinger learning model of students' mathematical communication skills. As the title in this study is the Influence of the Treffinger Learning Model on students' mathematical communication skills. Since the title in this study is the influence of Treffinger Learning Model on students' mathematical

communication skills, therefore it aims to find out the influence of the Treffinger learning model on students' mathematical communication skills.

METHODS

This research was carried out in Bulagi 1 High School, Bulagi District, Banggai Islands, Central Sulawesi Province, in the 2018-2019 academic year. This research was conducted in

the 2nd semester of the 2018-2019 school year. This type of research is a Quasi-Experimental study. This study investigated the presence or absence of influence by giving treatment to the experimental group and comparing it to the group that was not given treatment (control group).

The design in this study is the pretest-posttest control group design as presented in the table below.

Table 1. Pretest-Posttest Control Group Research Design

Group	Pre-test (O)	Treatment	Post-test (P)
Experimental Group (A_1)	A_1O	M	A_1P
Control Group (A_2)	A_2O	S	A_2P

Description:

A_1O = Pre-test evaluation results of the experimental class before treatment

A_2O = Pre-test evaluation results of the control class before treatment

A_1P = Post-test Evaluation results of experimental class after treatment

A_2P = Post-test evaluation results of the control class after treatment

M = Treatment of Treffinger learning model

S = Treatment of STAD type cooperative learning model

The population in this study were all students of 10th grade of Senior High School 1 Bulagi, Banggai district, with 146 total students. 10th grade, Mia 1 = 27 students, Mia 2 = 24 students, X IBD = 16 students, X Is 1 = 26 students, X Is 2 = 27 students and X Is 3 = 26. (Data source of Senior High School 1 Bulagi).

The sampling technique in this study was Purposive Sampling. This sampling technique was the technique that most likely to be done along with the Pretest-Posttest Control Group Design. Researchers used this sampling technique because of the consideration of the situation and circumstances in the field of research.

Based on the consideration of the number of classes in 10th grade, Senior high school 1 Bulagi which divided

into three majors because they use the 2013 curriculum, with a total of 6 classes namely X Mia 1, X Mia 2, X IBD, X Is 1, X Is 2 and X Is 3. Since this study required two classes as research samples and one class as instrument validation classes, the researchers took class X Mia 1 and class X Mia 2 as samples by considering the average of students' initial ability and the interest on mathematics in both classes are almost the same. The classroom conditions are conducive to the application of new learning models, in this case the Treffinger learning model.

The data analysis technique started with descriptive data processing. Data processing was done by determining the size of data concentration and data distribution,

such as the average value (mean), median, mode, standard deviation, and variance. Followed by data normality test using estimated errors, regression

linearity test, homogeneous variance test, and finally, the research hypothesis test using a one-way covariate analysis (Anacova) test.

Figure 1. Research Flow Chart

RESULTS AND DISCUSSION

This data is presented in four data groups, namely the results of the mathematical communication skills of students in the experimental group before treatment with the Treffinger learning model, The results of the mathematical communication skills of students in the experimental group after treatment with *Treffinger* learning models, The results of mathematical students' procedural understanding abilities in the control group before treatment with *Student Teams Achievement Achievement Division* (STAD) type cooperative learning model, and the last is the results of mathematical communication skills of students in the control group after

treatment with the STAD cooperative learning model.

Indicators of mathematical communication skills, namely: 1) Writing, namely explaining an idea or solution to a problem or image using one's own language; 2) Drawing, namely explaining ideas or solutions to mathematical problems in the form of pictures; 3) Mathematical expressions, namely expressing everyday problems or events in the language of a mathematical model.

Based on indicators of students' mathematical communication skills who are taught with the Treffinger model with the cooperative learning model of the STAD type, the researcher can provide a comparison of

the two learning models as follows: 1. For the first indicator, namely writing, which is explaining an idea or solution to a problem or image in your own language. That the Treffinger learning model has the advantage of giving students the opportunity to understand concepts by solving a problem. Whereas in groups of students who were taught with the cooperative learning model stad type, it was more dependent on the group's ability, not on individual abilities 2. The second indicator, namely Drawing, shows that students who are taught with the Treffinger learning model are more dominant, similar to the first indicator, the advantages or advantages of the Treffinger learning model are seen in this indicator compared to the STAD type cooperative learning model. 1. Mathematical expressions. Here,

students are given space to express themselves because one of the advantages of the Treffinger model is that the Treffinger learning model develops students' thinking abilities because problems are presented at the beginning of learning and gives students the flexibility to find their own solution directions. Whereas in the group of students who were taught with the cooperative learning model type STAD, they had shortcomings, including the inability of the group of students to give ideas in the form of mathematical ideas and explain mathematical ideas and relations with pictures. This deficiency is an advantage in the Treffinger learning model that is not found in the STAD cooperative learning model (Rafrin, 2015).

Pre-Test Data Results of Mathematical Communication Capabilities in the Experimental Group Before treatment

Figure 2. Pre-Test of Mathematical Communication Capabilities of Experimental Groups.

Figure 2 above describes the results of students' mathematical communication skills in the experimental class before treatment

using the Treffinger learning model obtained a minimum score of 14, a maximum score of 48, a range of 34, many classes (interval classes) are 6.

Frequency shows the number of students who get the lowest score to the highest value by dividing 6 interval

classes. Figure 1 above is obtained from the following table.

Post-Test Data Results of Mathematical Communication Capabilities in the Experimental Group After treatment.

Figure 3. Post-Test of Mathematical Communication Ability in the Experimental Group

Figure 3 above shows the results of the mathematical communication skills test after being given treatment by teaching the Treffinger learning model, the minimum score is 40, the

maximum score is 57, the range is 17 and the number of interval classes is 6 classes. The highest number of frequencies that get the maximum score is 10.

Pre-Test Data Results of Mathematical Communication Capabilities in the Control Group Before treatment

Figure 4. Pre-Test Data Results of Mathematical Communication Skills of Students in the Control Group

Figure 4 above shows that the average score of students' mathematical communication skills in the control class before being taught using the STAD cooperative learning model is 35 with a standard deviation (SD) of 3.36. Data on the results of students' mathematical communication

skills in the control group before being given treatment using the STAD cooperative learning model on the Trigonometry material obtained a minimum score of 25, a maximum score of 48, a range of 23, many classes (interval class) as many as 6.

Post-Test Data Result of Mathematical Communication Ability in the Control Group After treatment

Figure 5. Data Histogram Post-Test Result of Students' Mathematical Communication Capabilities in the Control Group.

Figure 6. Comparison of the average level of students' mathematical communication skills results in each treatment group

Figure 5 above describes the students' mathematical communication skills for the control class after being given treatment. From the histogram image, it can be explained that the minimum score is 34, the maximum score is 56, the range is 22, the number of classes (K) 6. The average score of students' mathematical communication skills in the control class after being taught using the STAD cooperative learning model is 47.5

The difference in the average level of students' mathematical communication skills taught by using Treffinger learning model and the average mathematical communication skills of students taught using the Student Team Achievement Division (STAD) cooperative learning model can be visualized in the following histogram;

In accordance with the research design using pretest and posttest for each treatment group, it appears that in the pre-test the control class group (learning with the STAD cooperative model) has an average score of 35 and the post test is 47.5. whereas in the experimental class group (Treffinger's learning model) it appears that the pre-test only has an average value of 32.5, this value is lower than the average value of the control class. However, in the post test results the experimental class obtained a value of 50.67. this means that the experimental class score is 3.17 higher than the value of the control class. Thus, that there are changes that occur before and after the implementation of the treffinger model learning on students' mathematical communication skills.

The existence of differences in students' mathematical communication abilities can be seen from the results of

the average calculation of the results of mathematical communication skills in each treatment group that the experimental group where students are taught with the *Treffinger* learning model is higher than the control group where students are taught using the *Student cooperative learning model. Team Achievement Division (STAD)*.

According to the hypothesis proposed in this study, it is assumed that "the mathematical communication skills of students taught by using the Treffinger learning model are higher than students taught by using the Student Team Achievement Division (STAD) cooperative learning model." So that the discussion of research results is based on the results of the research treatment using two different learning models, namely the

Treffinger learning model in the experimental group, class X Mia 1 with 27 students and the cooperative learning model type, Student Teams Achievement Division (STAD) in the control group, class X with 24 students, in which the researchers controlled the mathematical communication skills of students from each treatment group through pre-tests. Before the learning process is delivered, controlling the mathematical communication skills of students firstly done by pre-testing students in each treatment group by using a mathematical communication ability test instrument that has been validated, reliability tested, differentiation tested, and the difficulty index tested for each test item so that it is appropriate to be used as a measurement tool to measure students' mathematical communication skills.

After knowing the initial ability of each sample group, then the two treatment groups learned by using a

different learning model with the provisions of the treatment, namely the experimental group was taught using the Treffinger learning model and the control group was taught using the Student Team Achievement Division cooperative learning model (STAD), where the cooperative learning model type Student Team Achievement Division (STAD) is one of the learning models commonly used in teaching and learning in Senior High School 1 Bulagi.

The results showed that the students' achievement and enhancement who were taught using Treffinger model were significantly higher than those taught using conventional model. The effectiveness of Treffinger model supported Pomalato (2005) study that the model not only enhance the students' mathematical ability but also positively contributed to their students' creative mathematical and problem solving ability. The Treffinger model enabled the students to express their ideas through speaking and/or writing. When working on tasks, students were asked to read and identify mathematical information given and also to write their arguments based on their point of views. The solution from teachers and students were then discussed (Alhaddad et al., 2015).

Once all the material has been completed taught, to judge the ability of communication mathematical students in each group post treatment by t -test or final test through the test instrument has divalidity, reliability test, test distinguishing, and test each item difficulty index test so that it is feasible to be used as a measuring tool

to measure students' mathematical communication skills.

From the data on the results of students' mathematical communication skills in each treatment group, testing and analysis was then carried out to see how much influence the *Treffinger* learning model had on students' mathematical communication skills . From the average results of students' mathematical communication skills described earlier, as well as the One Way ANACOVA calculation, there are differences in students' mathematical communication skills taught by the *Treffinger* learning model and students' mathematical communication skills taught using cooperative learning model type *Student Team Achievement Division* (STAD).

The average score of the ability of communication mathematical students who are taught by teaching model *Treffinger* higher than the average score of the ability of communication mathematical students are taught is taught by using cooperative learning model *Student Team Achievement Division* (STAD).

From the description above, it can be seen that the *Treffinger* learning model is a learning model whose achievements are superior to the *Student Teams Achievement Division* (STAD) cooperative learning model, which is a learning model commonly used in the teaching and learning process of class X teachers at SMA Negeri 1 Bulagi. The *Treffinger* learning model is a learning model that invites students to think creatively in improving their mathematical communication skills by looking for directions for solving and choosing the right solution to solve their own

problems in ways that students want, namely the ability to think creatively Elis et al. (2018) and can improve critical thinking skills (Ridwan et al., 2019; Sumiara et al., 2019). Students' mathematical communication skills are a very influential aspect of students' academic success. This study strengthens previous research that the Treffinger learning model can affect students' mathematical communication skills Nurjanah (2019), and can increase students' academic success (Khan et al., 2017). This is in line with and supports the research stated by Alhaddad et al. (2015) that the Treffinger learning model has an influence on students' mathematical communication skills.

Alhaddad et al. (2015) show that the application of the Treffinger model in the learning process of mathematics makes a positive contribution to the development or improvement of students' creative abilities and mathematical problem solving abilities. By using the Treffinger model, improving students' mathematical communication skills can be done systematically which focuses on the learning process. Meanwhile, conventional mathematics learning, which begins with an explanation of the topic, explains the learning material and is followed by giving examples and exercises to students on how to complete these exercises, tends to make students passive, unable to develop creative thinking skills, develop mathematical ideas, or difficult for students to make decisions.

CONCLUSION

Based on the hypothesis and the results of data analysis with

prerequisites through the Normality Test, Regression Linearity Test, and Homogeneity Test, it can be concluded that there are differences in mathematical communication skills of students taught by using the Treffinger learning model and students taught by using the STAD Cooperative learning model namely communication skills mathematical students who are taught by using the Treffinger learning model are higher than the mathematical communication skills of students who are taught using the STAD Cooperative learning model. Thus, the study concludes that there is a significant influence of the Treffinger learning model on students' mathematical communication skills. And through the results of this study, it is highly recommended to use Treffinger model to improve mathematical student communication skill.

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