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The Trial of the Cooperative Learning Models of Two Stay-Two Stray and Talking Stick on Students' Mathematical Communication

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***Abstract*—One of the causes of low learning achievement in mathematics is that it has not used various learning models in improving their mathematical communication skills maximally. The purpose of this study is to determine the effect of the use of Two Stay-Two Stray and Talking Stick in mathematical communication skills and to see the differences of influence between the two. This study used an experimental method for eight-grade students of SMP (equals to Junior High School) level. The population of this were 280 eight graders; and two groups were taken randomly as the sample, namely Class VIII A as Experiment I and VIII C class as Experiment II. The results show that Two Stay-Two Stray and Talking Stick give significant effects on students' mathematical communication and there were differences of influence between the two learning models. Therefore, the teacher is expected to provide an evaluation in the form of questions that are routinely conducted at the end of discussion independently. The students shall be given the opportunity to explain the results of the discussion in front of the class to see and to measure the level of understanding. It is also to evaluate the suitability of the discussion results during the presentation.**

Keywords—learning models; two stay-two stray; talking stick; mathematical communication, mathematics

I. INTRODUCTION

Life constantly changes, including in the fields of, but not limited to, technology, society, teaching, etc. To adjust teaching to changes, teachers must be able to follow developments [1]. The phenomenon of low achievement in mathematics is caused by teacher's inappropriate choice of teaching and learning strategies. Therefore, students have a weak understanding of concepts and skills. The use of traditional teaching and learning strategies in the form of memorization, numeracy skills, speed, end results, and narrow insights is in stark contrast to modern teaching and learning strategies that prioritize broad understanding, discovery, process, accuracy, and insight in order to straighten and facilitate students learn to count and other branches of mathematics [1] and help students to achieve basic mathematical abilities that include mathematical understanding, problem solving, reasoning, connection and communication [2]. There is a need of an effort to change in teaching and learning strategies that can be harmonized with students' mathematical skills. One of them is mastering mathematical communication skills.

In the world of education, one of the elements that is often studied in its influence with activeness and student learning outcomes is the learning model used by the teacher in the classroom. Learning models enable teacher to help students getting information, ideas, skills, ways of thinking and expressing ideas. Learning model is a conceptual framework that describes systematic procedures in organizing learning experiences that will be given to achieve certain goals. However, the use of learning models alone is not enough to improve student learning outcomes in certain materials. In addition, the density of material in curriculum causes teacher to concentrate only on the completion of material. Therefore, teacher does not have time to think about the way to make it easier for students to understand the material. This causes less interaction between teachers and students; and the class becomes a silent class without sound. Some learning models that are widely used in mathematics learning research are the Two Stay-Two Stray method and the Talking Stick Type Cooperative Learning Model. Some research results show that the use of Two Stay-Two Stray learning model affects students' learning outcomes [3-5]. Likewise, the Talking Stick Cooperative Learning model also influences student learning outcomes [6-8].

Based on the explanations about the previous researches, there is a space that has not been touched for a research in the real of communication. This is the basis for this research to be carried out. Moreover, on this occasion, the research was

conducted by combining two types of learning models with the aim of getting maximum results by fair and balanced treatment. In previous studies, the control class was only given an expository method or lecture. Therefore, on this occasion, the research gave treatment in the form of the Two Stay-Two Stray type as a model in the control class and the Talking Stick type as the method applied in the experimental class.

II. Literature Review

A. Cooperative Learning Model

Cooperative learning model is a learning model that focuses on collaboration among students through small learning groups where students learn and work collaboratively with other 4-6 group members in heterogeneous group structures [9]. Cooperative learning is currently widely used to realize student-centered teaching and learning activities, especially to overcome problems found by teachers in activating students, who cannot cooperate with others, who are aggressive, and do not care for others. Nevertheless, the cooperative learning model can be used in various subjects and ages [10]. Students are the main actors and teachers are motivators, learning engineers, inspiratory, and facilitators [11]. Roger and David Johnson argue that not all group-works can be considered cooperative learning. There are several characteristics of cooperative learning. They are, among others, each member has a role; there is a direct interaction between students; each group member is responsible for self-learning and also groupmates; teacher helps to develop interpersonal skills to only interact with the group when the group needs [10].

B. Cooperative Learning Model of Talking Stick Type

The Talking Stick type is a cooperative learning model that helps to increase the students' activeness, participation, knowledge, courage to express their opinions and readiness to answer and/or respond to problems/questions [12]. The Talking Stick Model is a learning method with the help of a stick. Students who holds a stick must answer questions from teacher after all students learn basic material [13]. According to Tarmizi, the steps are as follows. First, teacher prepares a stick [12]. Second, teacher delivers the main material, then provides the opportunity for students to read and to learn the material. Third, after reading the book and learning it, students close the book. Fourth, teacher takes the stick and gives it to a student, then teacher ask a question and student who holds the stick must answer it until most students receive question from the teacher. Fifth, teacher provides conclusions. Sixth and seven are evaluation and closing. In this model, there are several advantages. They are, among others, to test students' readiness, to train students to understand the material quickly, and to be more active in learning (learn before the lesson begins). In addition, this method also has several drawbacks. They are, among others, to make student becoming nervous, students tense and afraid of questions that will be given by the teacher.

C. Cooperative Learning Model of Two Stay-Two Stray Type

Kagan developed the Two Stay-Two Stray [14]. This type can be used in all subjects for all ages. Two Stay-Two Stray structure gives groups opportunity to share results and information with other groups [11]. It is a learning model that can train students to think critically, creatively, and effectively; to help each other in problem solving; and to encourage each other to excel in their groups. The Two Stay-Two Stray enable students have to interact with other groups and compare results of their works so that the learning process can run effectively [15]. Learning that puts students in charge of the learning process can make students more aware of the concepts learned during the learning process. Students construct their own learning concepts and solutions to the problems they face themselves. Therefore, students are not supposed to depend on teachers to learn, but should be independent in learning throughout their lives [16].

D. Student's Mathematical Communication

Mathematical communication skills are one of important goals in mathematics learning. Jihad clearly mentions that one of the basic abilities of Mathematics is mathematical communication [2]. Mathematical communication gives the understanding that the material taught to students is not used as memorization. It is used as a material that must be searched for truth and understood in accordance with the power of each student. At the next stage, students communicate their understandings logically and clearly to their friends, teachers, and other people both in writing and verbal.

The indicators of mathematical communication, according to Jihad include [2] (1) connecting real objects, images, and diagrams into mathematical ideas; (2) explaining ideas, situations, and mathematical relations in writing or verbally with real objects, images, graphs and algebra; (3) stating daily events in a language or mathematical symbol; (4) listening, discussing, and writing topics of mathematics; (5) reading with understanding written mathematical presentation; (6) making conjuncture, compile arguments, formulate definitions, and generalizations; and (7) explaining and making questions of mathematics. Based on these indicators, this research concludes mathematical communication indicators as follows. (1) The ability to connect real objects into mathematical ideas; (2) The ability to express everyday events in a language or mathematical symbols; (3) The ability to listen, to discuss, and to write topics of mathematics.

III. Methods

The population of this research were eighth graders of a junior high school in a public junior high schools. It consisted of seven classes with a total of 280 students. This study used a random sampling due to the percentage of students with high, medium, and low abilities that were divided equally. Therefore, the ability between classes is not much different. The chosen class is Class VIII A (experimental class) using the Talking Stick type and Class VIII C (control class) using the Two Stay-Two Stray. The initial test was used to find out the initial conditions before student were treated so that they can measure differences that occur after the treatment.

This research was an experimental method because in conducting research, it gave certain treatments to find out the relationship between the treatments given with certain aspects. The treatment covered the use of cooperative learning models,

to be precise the talking stick in the experimental class and the Two Stay-Two Stray in the control class. The aspect to be measured is students' mathematical communication. Hence, the independent variable of this research was the use of cooperative learning models of talking stick and Two Stay-Two Stray, while the dependent variable is students' mathematical communication.

IV. Results and Discussion

The research data were obtained through initial test activities (pretest) and final test (posttest) in the Experiment Class I and Experiment Class II. The data obtained is raw data that were used in testing normality, homogeneity, and the average difference test. The initial test data (pretest) that were obtained is presented in Table 1, as follows.

TABLE I. Description of the Calculation to Search for Frequency Distribution Table

1	Experiment 1		Experiment 2	
	Pretest	*Posttest*	*Pretest*	*Posttest*
Number of students	32	32	32	32
Highest	75	90	63	80
Lowest	30	43	24	34
Range	45	47	39	46
Total	1608	2200	1414	1944
Average	50,25	68,75	44,20	60,75
Variant	158,25	176,35	213,16	166,41
Standard Deviation	12.58	13,28	14,60	12,90

Based on Table 1, the average pretest of Experiment Class I was 50.25 and the posttest was 68.75. Therefore, the difference is 18.50. The average pretest of Experiment Class II was 44.20 and the posttest was 60.75. The average pretest and posttest results have increased by 16.55. The average posttest value of Experiment Class I is greater than the average posttest of Experiment Class II. In the sample data of the two classes, there are differences of mathematical communication between the students with Talking Stick and the students with Two-Stay Two-Stray.

A. Hypothesis Testing

1) Significant test

TABLE II. Results of Calculation of Significance Tests

Subject	Criteria of Testing Tcount>Ttable	Hypothesis	Interpretation
Experiment I	8,49 > 2,037	H_0 rejected	Significant
Experiment II	5,64 >2,037	H_0 rejected	Significant

The significant test was conducted to find out whether mathematics learning with Talking Stick and Two Stay-Two Stray had a significant effect or not. The results of the significant test between pretest and posttest of Experiment Class I shows that the t_{count} = 8.49 and $t_{(0.975)(31)}$ = 2.037. Therefore, $t_{count} = t_{table}$ is obtained. It means that H_0 is rejected. The mathematics learning with Talking Stick has a significant effect on the significance level of 5%.

The results of the significant test between pretest and posttest of Experiment Class I shows that the t_{count} = 5.64 and $t_{(0.975)(31)}$ = 2.037. Therefore, $t_{count} > t_{table}$ is obtained. It means that H0 is rejected. This explains that the influence of mathematics learning with Two Stay-Two Stray is on the significant level of 5%.

B. Two Average Difference Tests

TABLE III. The Results of Average Difference Test Calculation

Subject	Tcount	$t_{(0,975)(62)}$	Criteria of Testing Tcount>Ttable	Interpretation
Pretest	1,77	1,999	-1,999 < 1,77 < 1,999	No average difference
Posttest	2,44	1,999	2,44 > 1,999	Having average difference

Based on the pretest, the average value of the Experiment Class I is 50.25 and the Experiment Class II is 44.20. By testing the hypothesis at the significant level $\alpha = 5\%$, it turns out to be $-t_{table}<t_{count}<t_{table}$ -1.99 <1.77 <1.99, then H_0 is accepted. This relationship shows that there is no difference in the average pretest between Experiments Class I and Class II. In other words, the initial abilities possessed by Experiment Class II and I are the same.

On the results of the posttest, the average value of the Experiment Class I is 68.75 and the Class II is 60.75. By testing the hypothesis at a significant level $\alpha = 5\%$ it turns out that $t_{count} > t_{table}$ is 2.44>1.999, then H_0 is rejected. This shows that there is a difference in the average posttest between the Experiment Class I and II, which means that the average posttest value of Experiment Class I is much better than the Experiment Class II.

C. Discussion

Based on the results of significant test on the posttest results, it is found that Talking Stick has a significant effect on students' mathematical communication skills. This is because all students must be actively involved and must be able to understand the ongoing teaching material. Students can never predict know when to speak since everything happens spontaneously. Demands that students must always be ready can increase students' motivation to keep trying to understand and to ask questions during the discussion process. Therefore, in the question and answer sessions and discussion of the whole groups, students already have the preparation and self-readiness to express their opinions in the forum.

This condition can lead to students 'motivation, activities, and skills in improving students' mathematical communication skills. This is also supported by the results of previous research that Talking Stick learning can improve students' learning outcomes and can foster communication skills in proposing opinion.

The results of significant tests on the Two Stay-Two Stray learning outcomes have a significant effect on students' mathematical communication skills. The Two Stay-Two Stray learning forces students to be actively involved in two discussions. The two discussions are the discussion in the small group and the discussion with other group members. Students in the discussion with other groups must share the results of the discussion in the small group. They also should and discuss the work of other groups with their own group work. This learning enables students to get the opportunity to improve their initial understanding because students' understanding arises from small discussions of various groups complements each other.

This condition can lead to students' motivation, activities, and skills in improving students' mathematical communication skills. The Two Stay-Two Stray learning is able to improve students' learning outcomes because the mechanism of the Two Stay-Two Stray learning prioritizes communication skills among students in small groups that are cross-communication in the matter of delivering opinions and exchanging ideas among members of the core group and other group members.

Based on the average difference test on the posttest results, it can be concluded that there are differences in the effect of mathematics learning for the students who get Talking Stick learning and the students who get Two Stay-Two Stray learning. These results show that the Talking Stick learning gives a better effect than Two Stay-Two Stray learning. This difference occurs because students with Talking Stick learning must be actively involved and must be able understand the ongoing teaching material. Students are demanded to be always ready. It can increase students' motivation to keep trying to understand and to ask questions for things that they do not understand during the discussion process. Nevertheless, in the question and answer session and the discussion of all groups, students already have the preparation and self-readiness to express their opinions in the forum. In Two Stay-Two Stray learning, the research found several obstacles, namely the role of students who did not run optimally in group activities. The Two Stay-Two Stray learning mechanism that holds two discussions to exchange answers were not used by the students to discuss and to analyze the differences of answers. Most students follow the answers of other groups. The level of students' understanding of the material can be less measured and observed because all are covered by answers that have been equated at the beginning.

This becomes the basis for differences of mathematical communication skills between students who use Talking Stick and students who use Two Stay-Two Stray. Students receive different input processes from one another. This will definitely have an effect on the output in the form of students' mathematical communication skills that are acquired differently. The two Stay-Two Stray learning process's ineffectiveness can be improved by maximizing the role of the teacher as a motivator and director. Teacher can give guidance to students about the meaning of Two Stay-Two Stray learning discussions. It actually gives students chances to improve their level of understanding, correct each other, complement each other, and lead the Two Stay-Two Stray discussion flow in accordance with existing procedures. Teacher also must be able to be more creative and to be able to modify learning activities with the needs that are appropriate to class conditions.

V. CONCLUSION

The Talking Stick learning has a significant effect on students' mathematical communication. Likewise, the Two Stay-Two Stray learning has a significant effect on students' mathematical communication. The results show that there were differences in the effect of mathematics learning between students who received Talking Stick learning and students who received Two Stay-Two Stray learning in terms of students' mathematical communication skills.

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