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Application of Cooperative Learning Model of Type Jigsaw and Two Stay-Two Stray Towards Mathematics Learning Outcomes of Self-Confidence of Students

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ABSTRACT
This study aims to describe the application of cooperative learning models type Jigsaw and Two Stay-Two Stray towards mathematics learning outcomes and students' self-confidence. This study is a quasi-experimental research with a nonequivalent group pretest-posttest design. The research population was all students of grade 10th of Vocational High School 1 Makassar. The sampling technique used random cluster sampling, and the samples in this study were class X AP 3 and X AK 2. The cooperative learning model type Jigsaw was applied in class X AP 3, while the TS-TS type was applied in class X AK 2. The instruments used in this study were tests and questionnaires. The criteria of effectiveness set by the researcher were used to test the effectiveness of the cooperative learning model's application. The results show that (1) the learning process using the cooperative learning model type Jigsaw and the TS-TS in learning mathematics of topic statistics was carried out well, student activities are in the very good category, and student responses after learning are very good; (2) the cooperative learning model type Jigsaw is not effective in learning mathematics because it does not satisfy the indicators of student learning outcomes and self-confidence; (3) the cooperative learning model type TS-TS is not effective in learning mathematics because it does not satisfy the indicators of self-confidence; (4) there are differences in mathematics learning outcomes and self-confidence between students who are taught using the cooperative learning model type Jigsaw and the TS-TS in grade 10th Vocational High School 1 Makassar.

Keywords: *Jigsaw, Two Stay-Two Stray, Learning Outcomes, Self-Confidence*.

1. INTRODUCTION

Mathematics is a universal science that underlies the development of modern science and technology. Mathematics has essential roles in various fields, and particularly in education, mathematics can improve students' thinking and analysis abilities. Therefore, mathematics is being compulsory subject from kindergarten to university level [1]. However, in school, mathematics is considered a scary and challenging lesson for students compared to the others. Consequently, they only come to the math class without willing to study it seriously, and therefore, student activities do not appear in the learning process. This problem seems since, in the learning process, teachers tend to transfer their knowledge to students' minds while students only take notes, follow examples, and work on practice problems without being involved in building concepts, principles, or structures based on their idea. Students do not get the opportunity to develop their ideas and try alternatives that they may use to solve problems [2].

Teachers should transfer knowledge to students and create an environment that supports learning activities [3]. Success in learning mathematics is an indicator of the achievement of the expected learning

process. The expected learning outcomes are mathematics learning outcomes that exceed the Minimum Completeness Criteria (KKM).

Meanwhile, Self-confidence also contributes much to the success of students in the learning process. It is because self-confidence is one of the essential requirements for individuals to develop activities to get learning achievement. In addition, self-confidence is not inherited from parents, but it is formed from interaction and development through individual and group learning processes. The formation of groups in the learning process allows students to communicate with their colleagues in conveying their ideas to generate confidence.

One of the factors of students' low learning outcomes and self-confidence is the method used by teachers in learning [4]. Based on the information obtained, teachers at Vocational High School 1 Makassar tend to use direct instruction methods to teach mathematics and hardly apply cooperative learning. Because they think they use collaborative learning or direct instruction, only one or two students understand the topic. In addition, it follows from the minimal knowledge of teachers about cooperative learning. Teachers have never heard about the cooperative learning model of type Jigsaw and the cooperative learning model of type TS-TS, so they have never applied them. Therefore, in this study, the researchers used the cooperative learning models of type Jigsaw type Two Stay – Two Stray (TS-TS) in learning mathematics at Vocational High School 1 Makassar with the topic of statistics.

Based on the problems above, the authors are interested in conducting a study entitled "The influence of applying the cooperative learning models of type Jigsaw and Two Stay-Two Stray on students' mathematics learning outcomes and self-confidence."

2. METHODS

This study is quasi-experimental research for finding the effect of specific treatments on other variables under controlled conditions. The research was conducted at Vocational High School 1 Makassar. The population of this study was all students of grade X of Vocational High School 1 Makassar. Assuming that the class grouping was homogeneous, the research samples were selected using the cluster random sampling method. Class X AP 3 was chosen as the experimental class 1 applying the cooperative learning model of type Jigsaw. Class AK 2 was selected as the experimental class 2 using the cooperative learning model of type TS-TS.

Students in both experimental classes were given a pretest and posttest in the form of learning outcomes tests and self-confidence questionnaires. The research design chart adopted from [2] is shown in Figure 1.

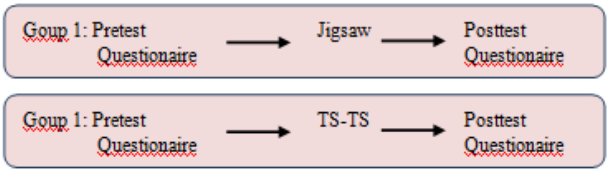

Figure 1. Chart of research design

Data collection instruments used were tests and non-tests forms. In this study, the indicators of the effectiveness of the cooperative learning model in learning mathematics are student activities, mathematics learning outcomes, student self-confidence, and student responses. Student activity data were obtained through observation of student activities carried out during the learning process. Learning outcomes tests and self-confidence questionnaires were given before and after the application of the learning models. Student responses were obtained from the student response questionnaire filled by students in both experimental classes at the last meeting of the learning process applying the cooperative learning models.

Students are said to have completed learning if they meet the minimum score of 70. Meanwhile, classical completeness is achieved when at least 80% of students in the class have achieved at least the minimum completeness criteria score. The self-confidence indicator is said to be fulfilled if the average score of the student's self-confidence scale exceeds 56 or is at least in the high category.

Table 1. Self-confidence scales

Scores	Interval	Categories
$20 < skor \leq 32$	$25\% - 39\%$	Very low
$32 < skor \leq 44$	$40\% - 39\%$	Low
$44 < skor \leq 56$	$55\% - 69\%$	Medium
$56 < skor \leq 68$	$70\% - 84\%$	High
$68 < skor \leq 80$	$85\% - 100\%$	Very high

The amount of increase in student learning outcomes and self-confidence before and after treatment is calculated using the N-Gain formula as follows:

$$N - Gain = \frac{Posstest\ Score - Pretest\ Score}{Maximum\ Score - Pretest\ Score}$$

Normalized gain holds if there is an improvement in student learning outcomes and self-

confidence. In this case, the average normalized gain must be at least in the medium category (0.30).

Table 2. Normalized gain criteria

Scores	Categories
$g \geq 0{,}70$	High
$0{,}30 \leq g < 0{,}70$	Medium
$g < 0{,}30$	Low

Hake ([5])

The data analysis techniques were descriptive and inferential statistical analysis to describe each data obtained descriptively and test the hypotheses related to applying cooperative learning models of types Jigsaw and TS-TS in mathematics learning. The statistical analysis was carried out using Software Statistical Package for Social Science (SPSS) version 22.

3. RESULTS AND DISCUSSION

The research was carried out in 6 meetings where 1 meeting for doing pretest, 1 meeting for conducting posttest, and 4 meetings for implementing mathematics learning process using Jigsaw cooperative learning model of type Jigsaw in class X AP 3 and cooperative learning model of type Two Stay-Two Stray in class X AK 2. Overall, the four learning meetings were carried out well.

Student activity data were obtained from observations carried out at each meeting by observing each student activity in class based on the observation instructions listed in the student activity observation sheet. In general, the learning outcomes of the two experimental classes are in a good category. After the learning process, student responses from both experimental classes reach a percentage of more than the minimum criteria for student responses (80%) and are categorized in the very good category. Therefore, the learning effectiveness criteria for student activities and responses are fulfilled.

From the descriptive statistical analysis of students' mathematics learning outcomes obtained from the pretest, posttest, and normalized gain, the recapitulations of data about mathematics learning outcomes of students taught using the cooperative learning models of type Jigsaw and the TS-TS was obtained.

Table 3. Descriptive statistical data of mathematics learning outcomes of students taught using cooperative learning model of type Jigsaw

Descriptions	Pre	Post	Gain
Sample size	25	25	25
Mean	37,32	68,00	0,49
Standard deviation	7,02	12,53	0,19
Minimum	14,00	47,00	0,19
Maximum	48,00	89,00	0,80

Table 3 shows that students' mathematics learning outcomes both before and after learning using the cooperative learning model of type Jigsaw have not reached the Minimum Completeness Criteria (MCC) (70). However, there is an increase in the average normalized gain score (0.49) which is in the medium category ($0.3 \leq g < 0.7$). This means that despite an increase in learning outcomes, the average final score of student learning outcomes probably can reach the MCC stated by the school.

Relevantly, research findings' of [5] indicated that teaching of mathematics through Jigsaw was more effective in increasing students' achievement.

Table 4. Descriptive statistical data of mathematics learning outcomes of students taught using cooperative learning model of type TS-TS

Descriptions	Pre	Post	Gain
Sample size	27	27	27
Mean	46,25	83,55	0,70
Standard deviation	11,58	83,00	0,71
Minimum	20,00	63,00	0,26
Maximum	64,00	98,00	0,95

Table 4 shows that students' learning outcomes after teaching using the cooperative learning model of type TS-TS reach an average MCC score of 70. There is an increase in learning outcomes by obtaining a normalized average gain score of 0.70, which is in the high category ($g \geq 0.7$). These results are in accordance with the results of [6] that the implementation of cooperative learning model Two Stay Two Stray increasing the results of students' mathematics learning.

Based on the MCC applied at Vocational High School 1 Makassar, especially in mathematics, which is 70, the level of completeness of classical student mathematics learning outcomes in class X AP 3 applying the cooperative learning model of type Jigsaw and X AK 2 using the cooperative learning model of type TS-TS can be seen in Table 5.

Table 5. Classical completeness of mathematics learning outcomes

	MCC	Percentage of classical completeness	
Jigsaw		Complete	Incomplete
Pretest	70	0%	100%
Posttest		44%	56%
TS-**TS**			

Pretest	70	0%	100%
Posttest		89%	11%

Table 5 shows that each classical completeness of students' mathematics learning outcomes in experimental classes taught using the cooperative learning models of type Jigsaw type and the TS-TS type reach 100% below the MCC in the pretest score. This means that none of the students' scores reach the MCC, categorized as incomplete.

Based on Table 5, only 44% of 25 students taught using the cooperative learning models of type Jigsaw reach at least an MCC score. This means that the number of students who achieve scores below the MCC is more than the number of students who achieve at least the MCC score. During the learning process, students enthusiastically work on the problems given. Students interact with group members in both expert and origin groups. However, it is undeniable that while working in the expert group, some students only copy the work of their friends. At the stage of explaining the material in the origin group, students only explain and agree to understand each other even though they do not understand their work. Therefore, some students only understand the part for which they are responsible. As a consequence, only a few students achieve at least an MCC score that is 70.

Table 5 also shows the post-test results of students taught using cooperative learning models of TS-TS where classically, only 89% of 27 students reach at least the MCC score. This means that the number of students who reach at least the MCC score is more than the number of students who do not reach the MCC score so that it is classified to be complete. The reason is that during the learning process, students collaborated in solving the given problems. In some groups that could not solve the problems, their group members, as guests, visited other groups to discuss the problems with them. In addition, some students also tested their friends' understanding by asking questions during the presentation process.

The results of processing data of students' self-confidence before and after learning using cooperative learning models of type Jigsaw and type TS-TS and the gain score are normalized.

Table 6. Descriptive statistical data of self-confidence of students taught using cooperative learning models of type Jigsaw

Description	Pre	Post	Gain
Sample size	25	25	25
Mean	50,49	53,34	0,07
Standard deviation	5,50	5,74	0,26
Minimum	39,54	46,19	-0,80
Maximum	61,56	65,50	0,50

Table 7. Descriptive statistical data of self-confidence of students taught using cooperative learning models of type TS-TS

Description	Pre	Post	Gain
Sample size	27	27	27
Mean	48,75	49,65	0,02
Standard deviation	4,77	5,18	0,14
Minimum	39,86	42,92	-0,39
Maximum	60,59	64,90	0,31

Based on Table 6 and Table 7, the average score of students' self-confidence before and after learning is in the medium category ($44 < score < 56$). In addition, the improvement of the average score of self-confidence of students taught using the cooperative learning model of type Jigsaw and TS-TS cooperative learning models is in a low category ($g \geq 0.3$).

Before testing the hypothesis, some requirement analyses were first conducted. These requirement analyses are the normality test using the Kolmogorov-Smirnov test and the homogeneity using the Levene test. All calculations were carried out with a significance level of 0.05 or 5%.

Table 8. The results of the normality test of mathematics learning outcomes

Jigsaw			
	Statistics	**Df**	**Sig.**
Posttest	0,108	25	0,200
Normalized gain	0,120	25	0,200
TS-TS			
Posttest	0,143	27	0,166
Normalized gain	0,124	27	0,200

Based on Table 8, the results of the posttest data analysis and the normalized gain of mathematics learning outcomes for both learning models show the P_value>α for =0.05. This means that H_0 is accepted, so the data on students' mathematics learning outcomes for the two experimental classes are said to be normally distributed.

Table 9. Results of self-confidence normality test

Jigsaw	Statistik	Df	Sig.
Posttest	0.141	25	0.200
Gain Ternormalisasi	0.141	25	0.200
TS-TS			
Posttest	0.136	27	0.200
Gain Ternormalisasi	0.160	27	0.74

Based on Table 9, the results of the posttest data analysis and the normalized gain of confidence for the two learning models show the P_value>α for =0.05.

This means that the students' self-confidence data for the two experimental classes are normally distributed.

Table 10. Homogeneity test results

Description	Levene Statistics	Df1	Df2	Sig
Hasil Belajar	1.467	1	50	0.231
Kepercayaan Diri	0.266	1	50	0.608

Table 10 shows that for students' mathematics learning outcomes, Levene's Statistic score is 1.467 with P_value=0.231 for =0.05 so that P_value>α. For self-confidence, the Levene's Statistic value is 0.266 with P_value=0.608 for =0.05 so that P_value>α. By these P_values, H_0 is accepted. This means that the data are homogeneous, or in other words, the variance of both experimental classes equals.

After the requirement tests, the hypotheses were tested using the t-test, assuming that the data is normally distributed. The data tested were students' posttest and self-confidence scores and normalized gain scores after being taught using the cooperative learning models of type Jigsaw and the TS-TS. The results of the posttest hypothesis test on the MCC score (69.9) can be seen in Table 11.

Table 11. Results of one-sample t-test of posttest

	Test value=69,9		
Posttest	T	Df	Sig. (2-tailed)
Jigsaw	-0.758	24	0.456
TS-TS	7.122	26	0.000

Table 11 shows that Sig. (2-tailed)>0.05for, the posttest result of students, taught using cooperative learning model of type Jigsaw which implies that $H_0$is accepted. Therefore, the average posttest score of X AP 3 students at SMK Negeri 1 Makassar is not more than or less than 69.9. This result follows from the data on the average posttest score of students in Table 3, which is 68. Meanwhile, the results of the TS-TS posttest analysis show Sig. (2-tailed) <0.05, which means $H_0$is rejected, and since the T value is 7.122, the average posttest score of X AK 2 students is significantly greater than 69.9. This result follows the data on the average posttest score of students in Table 4, which is 83.55.

The normalized gain hypothesis test results of student learning outcomes to the lower boundary of the medium category (0.29) can be seen in Table 12.

Table 12. Results of the normalized gain one-sample t-test

Gain	Test value=0,29		
	T	Df	Sig. (2-tailed)
Jigsaw	5.264	24	0.000
TS-TS	12.896	26	0.000

Table 12 shows Sig. (2-tailed) <0.05, which meansH_0 is rejected for the posttest result of students taught using the cooperative learning model of type Jigsaw. In addition, since the T value is 5.264, the average normalized gain score of learning outcomes of class X AP 3 students is significantly greater than 0.29. This follows from the average normalized score of student learning outcomes shown in Table 3, which is 0.49. Therefore, it can be concluded that there is an increase in the moderate category in learning outcomes of students taught using the cooperative learning model of type Jigsaw. Even though the average learning outcome score has not yet reached the MCC score. Failure in learning cannot be separated from the various factors, such as the non-optimal implementation due to miscommunication between students and teachers. Students lack preparation before the test. Many students complained that they had not yet studied, arguing that they did not know about the schedule of the posttest and did not have time to study because of many other subject assignments that had to be completed. The timing of conducting the posttest was not appropriate because it coincided with the final exam of the even semester.

Table 12 also Sig. (2-tailed) <0.05 for the posttest result of students taught using the cooperative learning model of type TS-TS implying that $H_0$is rejected. In addition, since the T value is 12.896, the average normalized gain score of learning outcomes of class X AK 2 students is significantly greater than 0.29. This corresponds to the average normalized gain score shown in Table 4, which is 0.70. Thus, it can be concluded that there was an increase in the high category of learning outcomes of students taught using the cooperative learning model of type TS-TS. This result follows the research results by [4] that the TS-TS type cooperative learning model can improve students' mathematics learning outcomes at school.

The hypothesis test results of the self-confidence scale score after learning can be seen in Table 13.

Table 13. The results of the one-sample t-test of self-confidence

	Test value=56		
	T	Df	Sig. (2-tailed)
Jigsaw	-2.316	24	0.029
TS-TS	-6.36	26	0.000

Table 13 shows Sig. (2-tailed) <0.05 for the self-confidence score of students taught using the cooperative learning model of type Jigsaw, which means that H_0 is rejected. In addition, the T score is -2.316, so that the average self-confidence score of X AP 3 students, in this case, is significantly less than 56. This corresponds to the average score of students' self-confidence after learning shown in Table 6 that is 53.34. Meanwhile, for the self-confidence score of students taught using the cooperative learning model of type TS-TS, the table shows (2-tailed) <0.05, which $H_0$was rejected. In addition, because the T value is -6.36, the average score of the students' self-confidence of class X AK 2 students is significantly less than 56. This is following the average self-confidence score after learning shown in Table 7 that is 49.65.

The normalized gain hypothesis test results of self-confidence outcomes to the lower boundary of the medium category (0.29) can be seen in Table 14.

Table 14. Results of the normalized gain one-sample t-test of self-confidence

	Test value=0,29		
	T	Df	Sig. (2-tailed)
Jigsaw	-4.165	24	0.000
TS-TS	-9.317	26	0.000

Table 14 shows (2-tailed) < 0.0001 for the normalized gain score of students taught using the cooperative learning model of type Jigsaw. If used$\alpha = 0.05$, then Sig. (2-tailed) <0.05, which means H_0it is rejected. In addition, the T value is -4.165. Therefore, the average normalized gain score of clas X AP 3 students is significantly less than 0.29. This corresponds with the average normalized gain score of students' self-confidence shown in Table 6, which is 0.07. Meanwhile, the normalized gain score of students was taught using the cooperative learning model of type Jigsaw, Sig. (2-tailed) < 0.0001. If$\alpha = 0.05$, Sig. (2-tailed) <0.05, which means H_0it is rejected. In addition, the T value is -9.317. Therefore, the average normalized gain score of self-confidence class X AK 2 students is significantly less than 0.29. This follows the average normalized gain score of students' self-confidence shown in Table 7, which is 0.02.

Based on the result analysis of self-confidence score, it can be seen that the cooperative learning models of type Jigsaw and TS-TS are not effective in improving the self-confidence of class X students on the topic of statistics. The reason is that students with moderate ability sometimes feel insecure and afraid to participate in group discussions and lack confidence in choosing situations that suit themselves. Therefore, they need big support from the teacher to tackle their problems. This is following what was stated by [7] that self-confidence could be influenced by several factors, including self-concept, self-esteem, experience, education, appearance, and so on.

Furthermore, to determine whether there are differences in mathematics learning outcomes and self-confidence between students taught using the cooperative learning models of type Jigsaw and TS-TS, a 2-way Manova test was carried out with the test criteria H_0rejected if rejected $F_{count} > F_{(o,o5;p,n_1+n_2-p-1)}$or the obtained significance value is less than 0.05. The results of the multivariate analysis for the two learning models can be seen in Table 15.

Table 15. Multivariate test

Effect		Value	F	Sig.
Model	Pillai's Trace	.418	17.610[b]	.000
	Wilks' Lambda	.582	17.610[b]	.000
	Hotelling's Trace	.719	17.610[b]	.000
	Roy's Largest Root	.719	17.610[b]	.000

Table 15 shows that in column model containing Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root model, the significances are 0.000 <0.05, implying that H_0 is rejected. Consequently, hypothesis H_1 is accepted, and we conclude that there is a difference between the cooperative learning models of type Jigsaw and TS-TS.

The difference between the two models can be seen in each variable in mathematics learning outcomes and students' self-confidence shown in Table 16.

Table 16. Tests of Between-Subjects Effects

Source	Dependent Variable	F	Sig.
Model	Learning outcomes	27,360	,000
	Self-Confidence	5,915	,019

In Table 16, the significant value of learning outcomes and self-confidence are <0.0001 and 0.019, respectively. So that for both variables, Sig < 0.05 implies that H_0it is rejected orH_1 is accepted. Thus, it can be concluded that there is a difference between

mathematics learning outcomes and students' self-confidence between students taught using the cooperative learning model of type Jigsaw and the TS-TS.

This difference occurs because the preparation of students in the experimental group II taught using the cooperative learning model of type Two Stay-Two Stray is better. They were more enthusiastic to carry out post-tests than the students in the experimental group I aught using the cooperative learning model of type Jigsaw.

Moreover, the difference in self-confidence between students taught using these two models can be seen from the average self-confidence scores after learning. The average score of the experimental group I was higher than that of the experimental group II. The same thing also happened to the increase of students' self-confidence. The average self-confidence increase of students of the experimental group I was higher than that of the experimental group II.

4. CONCLUSION

Based on the results of data analysis and discussion, several conclusions can be drawn as follows:

a) The average scores of students' mathematics learning outcomes on the topic of Statistics before learning using cooperative learning models of type Jigsaw and the TS-TS, respectively, are 37.32 and 46.25, below the MCC (70). After learning, these average scores increase to 68.00 and 83.55, respectively.

b) The average self-confidence scores of students before and after applying the cooperative learning of type Jigsaw and TS-TS are not significantly different. They are below the average of the student self-confidence score in the medium category that is 56. The average score of the students' self-confidence before applying the cooperative learning of type Jigsaw and TS-TS are 50.49 and 48.75, respectively. After learning, these average scores become 53.34 and 49.65, respectively.

c) Student activities during the application of cooperative learning models of type Jigsaw type and TS-TS type on the topic of Statistics are very active.

d) Students have a positive response of more than 80% categorized in very good after learning mathematics using cooperative learning models of types Jigsaw and TS-TS on Statistics. Student responses are 84% of 25 students and 85% of 27 students, respectively.

e) The application of the cooperative learning of type Jigsaw is not effective in learning mathematics on the topic of Statistics since the criteria for learning effectiveness, indicators of learning outcomes, and self-confidence are not satisfied.

f) The application of the cooperative learning of type Jigsaw is not effective in learning mathematics on the topic of Statistics since the criteria for learning effectiveness, indicators of learning outcomes, and self-confidence are not satisfied.

g) There are differences in mathematics learning outcomes and self-confidence between students taught using cooperative learning models of type Jigsaw and the TS-TS.

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