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The Effect of TAI and STAD Strategy towards Learning Outcomes Reviewed from Mathematical Communication Skill

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Abstract This research was conducted to know the difference in the effect of Team Assisted Individualization (TAI) and Student Teams Achievement Division (STAD) strategy on mathematics learning outcomes. This research also aimed to know the difference in the effect of mathematical communication skills on mathematics learning outcomes and the interaction between TAI and STAD strategy and mathematical communication skills in vocational high school. The research type used was experimental research with a quasi-experimental design as the research design. The cluster random sampling was used to obtain two sample classes, namely the experimental class X F consisting of 36 students and the control class X A consisting of 36 students of class X students in SMK Negeri 1 Pedan in the 2019/2020 school year. The experimental class was conducted with TAI strategy and the control class with STAD strategy. The duration of the experimental learning was three meetings and one meeting for examination. The examination result used two-way ANOVA with the unequal cell to know the conclusion. The finding showed that there was an effect of the implementation of TAI and STAD strategy and also mathematical communication skills on mathematics learning outcomes. The learning using TAI strategy produced better mathematics learning outcomes than using the STAD strategy. Moreover, the high-category of mathematical communication skills was better than the medium and low ones. However, there was no interaction between learning strategy and mathematical communication skills on mathematics learning outcomes.

Keywords TAI, STAD, Mathematical Communication, Mathematics Learning Outcomes

1. Introduction

Education was often interpreted as a human effort to build and foster his personality by the values contained in society. The Law of the Republic of Indonesia Number 20 of 2003 about the National Education System Chapter I Article 1 defines education as a conscious and planned effort to create an atmosphere of learning and learning process so students actively develop their potential to have religious-spiritual strength, control self, personality, intelligence, noble character, and the skills needed by himself, society, nation, and by country. The education process directs humans to develop their potential and improve their skills. According to Sanjaya [31], the atmosphere of learning was directed so students could develop their potential, it meant the educational process must be oriented on students (student active learning).

The result of the Program for International Student Associations (PISA) in 2015 showed that the mathematics learning outcome of students in Indonesia was ranked 63 out of 69 countries that were evaluated. The average math score in PISA 2015 was 386, these results were considered worrisome. Even though the rank in mathematics had increased from PISA 2012 which was only ranked 64 out of 69 countries that were evaluated, the result was still lagging behind other countries in Southeast Asia such as Thailand and Vietnam which scored better than Indonesia. This gave Indonesia the opportunity to improve the quality of education, especially mathematics [29].

Mathematics was still a problem for most of the students. Many students thought that mathematics was a scary subject, especially when they were facing the national examination. This could be seen from the average results of the national examination for vocational high school in the last five years. The 2015 national examination result for mathematics was 48.24%, the 2016 was 40.04%, the 2017 was 36.81%, the 2018 was 33.73%, and the 2019 was 35,76%. The results of the national examination in mathematics were the lowest compared to other subjects tested at the national examination [21].

Low learning outcomes in mathematics could be caused

by several factors from teachers and students. Implementation of learning strategies by teachers was still unable to optimize the learning process. Many teachers still used the conventional strategy which caused students to be less active during the learning process. The ability of teachers to determine the strategy used in the learning process had a major influence on achieving learning objectives. According to Sanjaya [31], a teacher needed to have the ability to design and implement various learning strategies deemed appropriate to the interests and talents of students and following the level of student development, including utilizing various learning resources and media to ensure learning effectiveness. Besides, Arseven [6] said that the use of learning models was needed to motivate students, eliminate their fears, help them develop cognitive abilities and other benefits such as creating meaningful learning, building relationships between mathematics and daily life, and developing problem-solving skills problem.

Alzahrani [3] concluded that dividing students into groups proved effective in increasing students' cooperation, interaction and could improve their communication. In line with these results, Tran [35] in his research also concluded that cooperative learning could enhance academic and affective growth because it provided an interactive learning approach. Also, research concluded by Saad that the teacher was satisfied and agreed that there was the involvement of the students during the cooperative learning process [30].

Cooperative learning strategies could also be used as an alternative to replace traditional learning. This was corroborated by research conducted by Chan and Idris [12] which concluded that students had better performance when using cooperative learning than conventional learning and cooperative learning could be used as an alternative to replace traditional learning. Cooperative learning strategies made students have to show their existence and their contribution to the group. Students were more flexible in expressing their opinions, experiences, and ideas in solving problems and students had their respective responsibilities so the learning process became more meaningful than teacher-centered learning. Research conducted by Alabekee et al [2] concluded that students valued cooperative learning models more than traditional learning models in terms of their learning experiences. Ling and Fung [24] said that there was no difference in student learning attitudes in cooperative learning so that it could be concluded that cooperative learning could be applied to students with low and high achievements. They also predicted that there would be success in education reform by using cooperative learning.

Another factor was students' low mathematical communication skills. According to Astuti & Leonard [8], mathematical communication skills were the ability of students to present mathematical problems through real objects, pictures, graphs, tables, and mathematical symbols. Meanwhile, according to the National Council of Mathematics Teachers (NCTM) in 2000 [27], mathematical communication was a way to share ideas and clarify understanding of learning mathematics. Communication bridges ideas into objects of reflection, improvement, discussion, and change. Students who had good mathematical communication skills could communicate the results of their discussions or opinions by writing and speech clearly, convincingly, and precisely in using mathematical language and symbols. Based on the above, mathematical communication was considered important and affects student learning outcomes. Astuti and Leonard [8] also concluded that there was a positive and significant effect of mathematical communication skills on mathematics learning achievement. Besides, Veloo et al. [36] said that a cooperative approach could improve students' understanding and their mathematical communication skills. It had been reported in several studies that cooperative strategies could improve learning outcomes and students become more active. Ariyawan and Hayatun [4] concluded that the higher the mathematical problem-solving ability, the mathematical communication skills of students also increased.

Applying the right strategy in providing material could affect students' learning outcomes. TAI strategy, STAD strategy, and students' mathematical communication skills were things that could improve student learning outcomes. Research conducted by Hobri et al. [18] concluded that cooperative learning had a significant effect on student achievement and attitudes on mathematics. Likewise, research from Awofala et al. [10] that discussed student-centered learning strategies such as TAI could improve students' attitudes on mathematics. The application of cooperative learning strategies could also improve performance among teachers and students.

Achdiyat and Andriyani [1] in their research which aimed to determine student learning outcomes of class XI using TAI learning concluded that application of the TAI strategy could improve student learning outcomes. In addition, Herawati [17] in her research obtained the results that the TAI learning model could be applied because it could improve student mathematics learning achievement, student activeness, and student interest in learning. Other results were students find it easier to understand the material, increase the willingness of students to completed assignments, and increase the frequency of communication. Muhamad et al. [26] in their research to know the result of applying the TAI learning model resulted that TAI strategy could increase students' mathematics learning outcomes. Besides, another research conducted Cahyaningsih [11] said that the application of the TAI cooperative learning model succeeded in increasing student achievement in mathematics. Saputra et al. [32] in their research to find out the effectiveness of TAI learning model in improving students' mathematical communication skills concluded that TAI was proven to be able to improve students' mathematical communication skills. The application of TAI learning model provided an opportunity for students to express their ideas and provide responses to the statements

of other students.

Kutnick et al. [23] concluded that applying cooperative learning in mathematics learning and other subjects provided further insights through communicative involvement to enhance learning. Also, Kumar and Singh [22] concluded that groups using STAD learning method could improve their problem-solving skills than using the traditional method. In addition, STAD learning could increase the interaction between students. In line with this, Ling et al. [25] concluded that STAD could make teachers and students more innovative and creative in learning. Some studies said that cooperative strategies could improve mathematics learning outcomes. Such as research conducted by Chan and Idris [12] who said that STAD cooperative learning model increased collaboration between students and teachers. It could also improve students' performance and ability to solve their problems. The application of the right strategy was expected to optimally improve students' abilities.

Other research by Asmoro [7] concluded that STAD model could improve students' mathematics learning outcomes. Alabekee et al. [2] in their research that aimed to examine the effects of traditional instruction, cooperative learning Jigsaw and STAD on student experience and learning outcomes in mathematics showed that students had higher scores when taught with cooperative learning models than traditional instruction. In addition, Hartati [16] in his research aimed at finding out the effects of using cooperative learning methods on mathematics learning in junior high schools concluded that cooperative learning STAD could increase student' mathematics learning outcomes and student learning activities. Hobri et al. [18] in their research which aimed to determine the effectiveness of using cooperative learning models for students' mathematics learning outcomes and attitudes and identify teacher perceptions about the application of cooperative learning in mathematics learning in Natore, Bangladesh showed that cooperative learning had a strong influence on students learning outcomes and student' attitudes towards mathematics learning. Besides, Jamalia et al. [19] in their research that investigated the differences in the effects of using STAD learning model and conventional learning model on students' mathematics learning outcomes concluded that the mathematics learning outcomes of students who were taught using the STAD learning model were higher than the mathematics learning outcomes of students who were taught using conventional learning model.

Based on the description above, the use of inappropriate learning strategies by the teacher caused low student learning outcomes. The use of cooperative strategies needed to be done as an effort to improve student learning outcomes. The results could be used as an effort to improve the quality of education that was still low and could be used as an illustration for teachers in determining the learning strategies to be used. Therefore, the researcher decided to conduct this research. This research was conducted to know: (1) the effect of TAI and STAD strategy on mathematics learning outcomes, (2) the effect of mathematical communication skills on mathematics learning outcomes, and (3) the interaction between TAI and STAD strategy and mathematical communication on mathematics learning outcomes.

2. Hypothesis

There were three hypotheses tested in this research (H_0), namely: (1) There was no effect of the TAI and STAD strategy on mathematics learning outcomes, (2) There was no effect of mathematical communication on mathematics learning outcomes, (3) There was no interaction between TAI and STAD strategy and mathematical communication skills on mathematics learning outcomes.

3. Methodology

3.1. Design of the Study

The research type used was experimental research with a quasi-experimental design as the research design. Arifin [5] said that the purpose of quasi-experimental design was to predict the conditions to be achieved through actual experiments and there was no control or manipulation of all relevant variables. The researcher could manipulate the condition by giving treatment to the subjects being studied.

The research design was shown in Table 1. In the research design, X_1 was the treatment using the TAI strategy, X_2 was the treatment using the STAD strategy, O_1 was the learning outcome after being treated using the TAI strategy, and O_2 was the learning outcome after being treated using the STAD strategy.

Table 1. Research Design

Classes	Treatment	Post-test
Experimental class	X_1	O_1
Control class	X_2	O_2

3.2. Sampling

The population of this research was the students from grade X of SMK Negeri 1 Pedan in the 2019/2020 school year. The sample selection was done using Cluster Random Sampling. This technique required sampling based on classes in the population, so the population was deliberately seen as classes, where the sample reflected the state of the classes. This research took two classes as the sample i.e. 36 students of X F experimental class and 36 students of X A control class. The experimental class was given treatment through the TAI strategy while the control class was given treatment through the STAD strategy. The balance test using the t-test was carried out on the sample class to ensure that the experimental class and the control class were in balanced ability. This test used the Odd Semester Midterm scores. The results found were that the experimental class and the control class had the same initial

ability or balanced.

3.3. Instrument

The techniques used for collecting data were in the form of tests, questionnaires, and documentation. The test was conducted to obtain student learning outcomes. The test instrument was in the form of an essay test consisting of 5 questions and was carried out at the end of the lesson. The questionnaire was used to determine students' mathematical communication skills. The questionnaire instrument contained 22 questions consisting of 16 positive questions and 6 negative questions. The document method was used for getting midterm grades. This value was used for determining the initial ability of the experimental class and the control class.

Validity test using the product-moment correlation formula and reliability test using the Alpha Cronbach formula were performed to find out whether the test and questionnaire instrument had met the validity and reliability requirements before being tested on students. Based on the validity test calculation, 5 items from the essay test were declared valid and could be used to obtain the value of student learning outcomes. Validity test for questionnaire instruments with 33 question items results that 22 question items were declared valid and could be used to obtain data on mathematical communication skills of students. Besides, based on calculations that had been obtained the value of the reliability of the test instrument was 0.81 and the questionnaire instrument was 0.85, it could be concluded that the two instruments had high reliability.

3.4. Procedures

Both sample classes were taught using different learning strategies for three meetings. The test was carried out at the fourth meeting after students had received instruction using TAI and STAD strategy. In the experimental class, learning begins with the teacher delivering the learning objectives, motivating students about the benefits of the material to be learned, and informing about the assessment techniques and methods used. In TAI learning, the teacher divides students into nine groups with each group consisting of six students, each student then gathers into his group. The teacher gave students' worksheets and students were required to work on their worksheets with a certain time limit. Students who had difficulty may ask one of the group members or the teacher. The results of students' worksheets were discussed in their respective groups. The results of student' worksheets would be examined whether true or not and presented to other groups. The teacher gave a brief explanation of the material being studied followed by giving a quiz to students. These steps were repeated until the third meeting. At the fourth meeting, students were given a test to measure student learning outcomes after being treated through the TAI strategy. After students completed the test, they completed a mathematical communication skills questionnaire. At the end of the lesson, the group with the highest average score got an award from the teacher.

In the control class, learning was given through the STAD strategy which started with the teacher explaining the learning objectives, motivating students about the benefits of the material to be learned, and informing them about the assessment techniques and methods used. In STAD learning, the teacher divides students into nine groups with each group consisting of six students. The teacher gave a brief explanation of the subject matter then the teacher gave a worksheet that must be done by each group with a certain time limit. Students who found it difficult could ask members of the group or the teacher. Students' worksheets were presented in front of other groups and corrected to determine the group achievements. At the fourth meeting, students were given a test to measure student achievement after being treated through the STAD strategy. At the end of the lesson, the group with the highest average score got an award from the teacher. After students completed the test, they completed a mathematical communication skills questionnaire.

Each group had at least one student with outstanding learning achievement. It was intended that students could help members of the group if there were problems that were not understood.

This research only measured student learning outcomes after being treated using different strategies and students' mathematical communication skills. Other variables during the learning process such as gender, motivation, and others were ignored.

3.5. Analysis of Data

The data analysis used to examine the hypothesis was the analysis of two-way ANOVA with the unequal cell. Before analysis, the data were tested using the Lilliefors method for normality test and Bartlett method for homogeneity test. A double comparison test using the Scheffe method was performed when there was a rejection of H_0 in the result of two-way variance analysis test with unequal cells.

4. Finding

Before the analysis, the prerequisite analysis was initially done by using the normality test and homogeneity test. Normality test was used to know whether a sample came from a distributed population was normal or not. The method used to test the normality was the Lilliefors method with 5% of the significance level. The data was considered as normally distributed if $L_{o\ max} < L_{table}$. The calculation of the normality test was helped by Microsoft Excel 2010.

Based on calculations, it was obtained from each group i.e. $L_{o\ max} < L_{table}$ with 5% of the significance level. Therefore, it could be concluded that the sample came from the normally distributed population.

Table 2. The Resume of the Homogeneity Test Analysis

Source	x_o^2	x_{table}^2	Decision	Conclusion
Learning Strategy (Between $A_1$and A_2)	2.91	3.84	$H_0$was accepted	Homogeneous
Mathematical Communication Skills (Among B_1, B_2 and B_3)	-0.23	5.99	$H_0$was accepted	Homogeneous

Table 3. The Resume of Two-way ANOVA with Unequal Cell

Source	Sum of Square	df	Mean Square	F_o	F_{table}	Decision
Learning Strategy (A)	391.24	1	391.24	4.76	3.99	$H_0$was rejected
Mathematical Communication (B)	1310.71	2	655.35	7.98	3.14	$H_0$was rejected
Interaction (AB)	183.21	2	91.61	1.11	3.14	$H_0$was accepted
Error (G)	5423.14	66	82.17	-	-	-
Total (T)	7308.30	71	-	-	-	-

The next test was the homogeneity test. A homogeneity test was used to know whether the available population had similar variances. The homogeneity test in this research used Barlette Test with 5% of the significance level. The data was considered as homogeneous if the calculation of the homogeneity test was helped by Microsoft Excel 2010 with the calculation result details that the researcher provided in Table 2.

Based on Table 2, it was obtained from each group i.e. with 5% of the significance level. Therefore, it could be concluded that the available population had similar variances.

The data had been collected and declared as normal and homogeneous then the hypothesis being tested using two-way ANOVA with unequal cell. The calculation of the hypothesis test was helped by Microsoft Excel 2010. The significance level of the test was 5% with the details of the calculation that the researcher provided in Table 3.

Based on Table 3 above, the result obtained after being tested by variance analysis test was $F_A$was in the amount of 4.76 and F_{table} with 5% significance level, 1 df nominator, and 66 df denominator was 3.99. Therefore, it showed that $F_A = 4.76 > F_{table} = 3.99$ which meant that the result of $H_0$was rejected and it could be concluded that there was a difference in the effect of the implementation of TAI and STAD strategy on mathematics learning outcomes.

The result obtained after the calculation of variance analysis test showed that $F_B$was in the amount of 7.98 and F_{table} with 5% of significance level, 2 df nominator, and 66 df denominator was 3.14 which meant that the result of H_0 testwas rejected and it could be concluded that there was an effect in students' mathematical communication skills on mathematics learning outcomes.

The result obtained after the calculation of variance analysis test showed that $F_{AB} = 1.11$ and F_{table} with 5% significance level, 2 df nominator, and df 66 denominator was 3.14. Therefore, it showed that $F_{AB} = 1.11 < F_{table} = 3.14$ which meant that the result of H_0 test was accepted and it could be concluded that there was no interaction between TAI and STAD strategy and the students' mathematical communication skills on mathematics learning outcomes.

The result of the three decisions of two-way ANOVA with unequal cell showed that two $H_0$was rejected and one $H_0$was accepted. The H_0 rejection caused the need for further testing after ANOVA i.e. double comparison test using Scheffe' Method with 5% significance level. The double comparison test consisted of the average comparison test between rows and the average comparison test between columns.

The hypothesis of the average comparison test between rows consisted of two factors so that it did not need further testing although H_0 was rejected. The two factors were the learning results of using TAI and STAD strategy. The average learning outcomes were reviewed from the mathematical communication that the researcher provided in Table 4 as follows.

Table 4. The Average Learning Outcomes Reviewed from Mathematical Communication Skills

Learning Strategy	Student's Mathematical Communication Skills			Marginal Average
	High	Medium	Low	
TAI	91.92	84.71	77.44	84.69
STAD	83.54	79.50	76.91	79.98
Marginal Average	87.73	82.11	77.18	

Based on Table 4, it showed that the learning marginal average using TAI strategy was better than the learning using STAD strategy. The hypothesis of the average comparison test between columns consisted of three factors so that it needed further testing after ANOVA. The purpose of the average comparison test between columns was to know which mathematical communication skills (high, medium, low) significantly had different average. The resume result of the average comparison test between columns was provided in Table 5 as follows.

Table 5. The Result Resume of the Average Comparison Test between Columns

H_0	F_o	F_{table}	Decision
$\mu_{.1} = \mu_{.2}$	5.00	6.27	$H_0$was accepted
$\mu_{.1} = \mu_{.3}$	15.32	6.27	$H_0$was rejected
$\mu_{.2} = \mu_{.3}$	3.34	6.27	$H_0$was accepted

Based on Table 5, it showed that the result of the decision for $\mu_{.1} = \mu_{.2}$ was accepted because $F_o = 5.00 < F_{table} = 6.27$ so it could be concluded that there was no difference between the marginal average of learning outcomes reviewed from high and medium mathematical communication skills.

The result for $\mu_{.1} = \mu_{.3}$ was rejected because $F_o = 15.32 > F_{table} = 6.27$. It could be interpreted that there was a different marginal average of learning outcomes reviewed from high and low mathematical communication skills. The marginal average reviewed from high-category mathematical communication skills was bigger than the marginal average of learning outcomes reviewed from low-category of mathematical communication skills so that it could be concluded that students' high-category of mathematical communication skills was better than students' low-category of mathematical communication skills.

The decision result for $\mu_{.2} = \mu_{.3}$was accepted because $F_o = 3.34 < F_{table} = 6.27$. It could be concluded that there was no different marginal average of learning outcomes reviewed from medium and low mathematical communication skills.

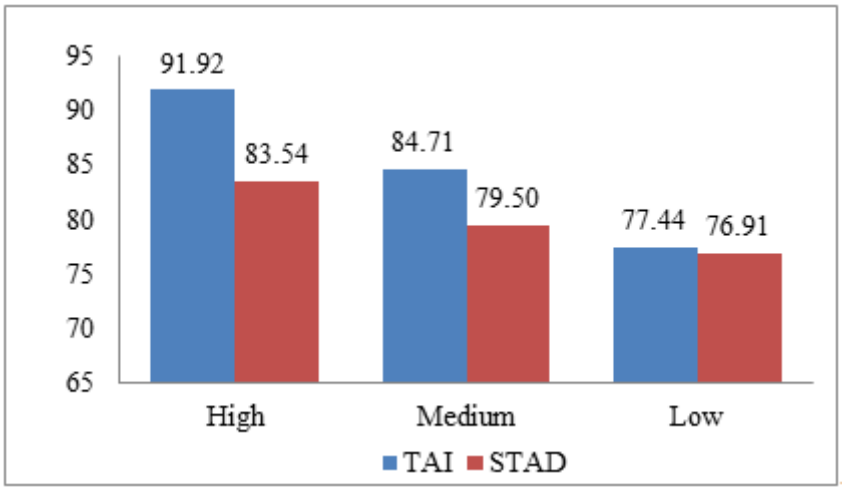
5. Discussion

The tests being conducted in this research were the balance test, the validity test and reliability instrument, the prerequisite analysis test, and the hypothesis test. The balance test showed to = 0.95 and $t_{table} = 1.99$ with 5% of the significance level. Since $t_o < t_{table}$ so it could be concluded that both classes had a similar beginning ability. The validity and reliability test were conducted to examine test items and questionnaires about mathematical communication skills. The validity test as the item test trial with 5 total items and the result of all items were valid with high-reliability test result i.e. 0.81. The reliability test result as a questionnaire trial about mathematical communication skills with 33 total items produced 22 items were stated as valid and 11 items were not valid. 22 valid items then were selected to be given to the experimental class and controlled class. The reliability test as a questionnaire trial test about mathematical communication skills was 0.85 which meant having a high-reliability score. The prerequisite analysis consisted of normality test and homogeneity test. The data collected in this research was normally distributed since the value of $L_{omax} < L_{table}$ and it came from the population that had similar variances because of $\chi_o^2 < \chi_{table}^2$with 5% of the significance level. The hypothesis test was conducted using two-way ANOVA with the unequal cell with 5% of the significance level to examine whether there was a different effect of two independent variables i.e. learning strategy (A) and mathematical communication (B) and to examine the interaction of learning strategy and mathematical communication (AB) on mathematics learning outcomes.

The result of the two-way ANOVA test with the unequal cell with 5% of the significance level produced $F_A = 4.76 > F_{table} = 3.99$ which meant the test decision i.e. H_0 was rejected and it could be concluded that there was an effect in the implementation of learning strategy on learning outcomes. This thing was in line with the research conducted by Herawati [17] which concluded that TAI learning model was effective to be implemented because it could increase the students' mathematics learning outcomes. The research conducted by Saputra et al. [32] also concluded that TAI learning model proved that it could increase student's mathematical communication skills. Moreover, the research conducted by Muhamad et al. [26] also concluded that there was an increase in students' mathematics learning outcomes after the implementation of a cooperative learning model i.e. TAI. Another research conducted by Ling et al. [25] showed that STAD usage in mathematics learning showed there was an increase in students' mathematics learning achievements. It was in line with the research conducted by Jamalia et al. [19] which produced a conclusion that there was an increase in students' mathematics learning outcomes that being taught using STAD learning model.

The hypothesis consisted of two factors i.e. TAI and STAD strategy so that there was no need to conduct double comparison but only by looking at the marginal average score. According to Table 4, it produced the marginal average score of the experimental class which was given a treatment using TAI strategy, which was higher than the marginal average of the controlled class which was given a treatment using STAD strategy. Itwas in line with Harsanti [15] in her research concluded that a class taught using TAI learning model had a better average score compared to a class taught using STAD learning model. In line with these results, Tarim and Akdeniz [34] concluded that the TAI method had a more significant effect than the STAD method. In addition, research conducted by Nisa and Hanggara [28] also concluded that TAI cooperative learning produced better mathematics learning outcomes than STAD cooperative learning.

The learning with TAI strategy produces better learning outcomes than the learning with STAD strategy. It was because, in TAI learning, every student was obligated to answer the given problems before being discussed in groups. It caused the students to know their weaknesses in a certain subject being learned so that the students could ask friends or teachers for help to solve the difficulties. TAI learning also minimized passive students in doing their assignments. Otherwise, in the learning with STAD strategy, there were still passive students in the discussion so that not all students did the assignments given to them. Not all the students' weaknesses in certain problems could be solved. Harsanti [15] said that in STAD learning, although the students were allowed to study in a group, the weak students would still rely on the smart ones.



Picture 1. Learning Outcomes Average Reviewed from Students' Mathematical Communication Skills

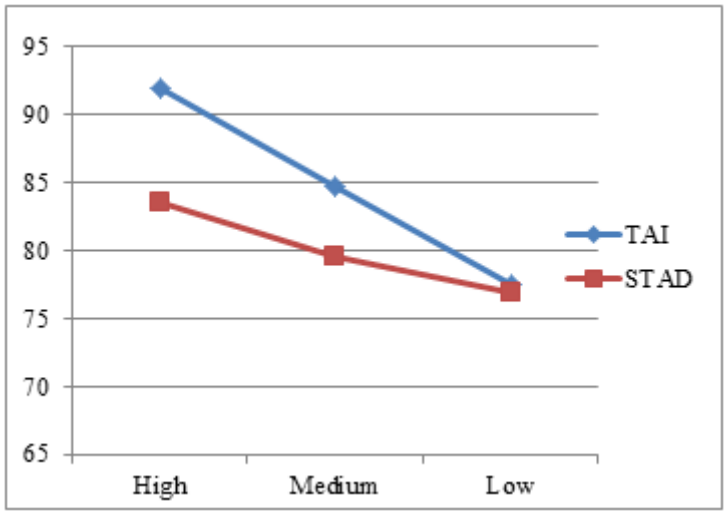
The students' learning outcomes reviewed from students' mathematical communication skills in Table 4 were shown in Picture 1.

The calculation result of two-way ANOVA with unequal cell test with 5% of the significance level was $F_B = 7.98 > F_{table} = 3.14$ which meant that test decision i.e. H_0 was rejected and it could be concluded that there was an effect on students' mathematical communication skills on mathematics learning outcomes. It was in line with Astuti and Leaonard's [8] opinion in their research that there was a positive and significant effect between students' mathematical communication skills and students' mathematics learning outcomes. Moreover, the research conducted by Fadillah [13] concluded that mathematical communication skills of students affect the learning outcomes of mathematics. Not all mathematical communication categories gave the same effect on learning outcomes, so it was needed to conduct a double average comparison test between columns to know which mathematical communication skill category gave better learning outcomes.

The result of the double average comparison test between columns produced a conclusion stating that the learning outcomes obtained from high-communication skills were higher than the low ones. The average of high-mathematical communication skills was 77.18. According to the average of students' learning outcomes, it could be concluded that the high-category of mathematical communication skills was better than medium- and low-mathematical communication skills. It was in line with the research conducted by Jamilatun [20] concluding that the learning outcomes of students' high-communication skills groups were better compared to the learning outcomes of students' medium- and low-communication skills groups. Another research conducted by Astuti [9] concluded that students with high-mathematical communication skills achieve better mathematics learning outcomes compared to the other students with medium- and low-mathematical communication skills.

The calculation result of two-way ANOVA with the unequal cell with 5% of the significance level produced $F_{AB} = 1.11 < F_{tabel} = 3.14$ which meant that decision result i.e. H0 was accepted and it could be concluded that there was no interaction between learning strategy and students' mathematical communication skills on mathematics learning outcomes. It was in line with Astuti [9] concluding that there was no interaction between learning strategy and mathematical communication skills on mathematics learning outcomes. Fitrianingsih [14] in her research also concluded that there was no interaction between learning strategy and students' communication outcomes on mathematics learning achievement. Additionally, Swastika et al [33] in their research also concluded that there was no interaction between learning model and mathematical communication skills on mathematics learning outcomes.

The profile of no interaction between learning strategy and mathematical communication skills on mathematics learning outcomes was shown in Picture 2 as follows:



Picture 2. The Profile of the Effect in Learning Strategy and Mathematical Communication Skills

Based on Picture 2, it could be seen that the learning outcomes data of the experimental and control class reviewed from the students' mathematical communication skills was not intersected. It showed that there was no significant interaction between learning strategy and mathematical communication skills on mathematics learning outcomes. Nevertheless, it could be seen that the learning outcomes average of the experimental class using TAI was higher than the learning outcomes average of the control class using STAD, either in high or medium and low-mathematical communication skills category. Moreover, based on Picture 2, it could be seen that the result of learning outcomes with high-mathematical communication skills was better compared to the result of learning outcomes with medium- and low-mathematical communication skills.

6. Conclusions

The results showed that there was an effect of the use of the TAI strategy and STAD strategy on mathematics learning outcomes. The marginal mean learning outcomes of the experimental class and the control class indicated that the experimental class had a greater mean learning outcome than the control class. Based on these results it could be concluded TAI strategy got better learning outcomes than STAD strategy. Another result showed that there was an effect of mathematical communication skills on mathematics learning outcomes. Mathematical communication skills in the high category were better than the medium and low categories. Based on this it could be concluded that mathematical communication skills affect student learning outcomes. Besides, other acquisition results indicate that there was no interaction between learning strategies and mathematical communication skills in mathematics learning outcomes. It meant that there was no interaction between TAI strategy and STAD strategy in terms of the mathematical communication skills of high, medium, and low categories of students on student learning outcomes. In general, the results of this research indicated that TAI and STAD had a positive impact on mathematics learning. Also, students' mathematical communication skills also affect mathematics learning outcomes.

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