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Comparative Study of Learning Outcomes Between Make a Match Type and Two Stay Two Stray Type Cooperative Learning Model on Hydrocarbon Materials

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Abstract: Comparative study of learning outcomes between make a match type and two stay two stray type cooperative learning model on hydrocarbon materials. Hydrocarbon compounds are one of the materials contained in chemistry lessons which are considered as difficult lesson, so an appropriate cooperative learning model is needed to understanding hydrocarbon materials. This study aims to compare the learning outcomes between the Make a Match type and the Two Stay Two Stray type cooperative learning model on hydrocarbon materials. This study carried out at SMK Tamansiswa Kisaran, North Sumatera. The sampling technique used saturated sampling (census), where the samples in consist of 2 class, that is class XII-1 applied the Make a Match and class XII-2 applied the Two Stay Two Stray, with 20 students in each class. Data were collected from pre-test and post-test, then analyzed statistically using t test. The results showed that the mean value of learning outcomes in the pretest-posttest in experimental class 1 is 27.5 and 77.0, while the mean value of learning outcomes in the pre-post-test in experimental class 2 is 25.3 and 77.8. The t-test was carried out using the independent sample test technique. The significant value (2-tailed) was 0.406<2.026, meaning that H_0 was accepted and Ha was rejected. Based on the results of the study, it can be concluded that there is no significant difference in student learning outcomes who use the Make a Match type with the Two Stay Two Stray type cooperative learning model on hydrocarbon materials
Keywords: Learning model, Learning outcomes, Make a Match, Two Stay Two Stray.

Abstrak: Studi Perbandingan hasil belajar antara model pembelajaran kooperatif tipe make a match dan tipe two stay two stray pada pokok bahasan hidrokarbon. *Senyawa hidrokarbon merupakan salah satu materi yang terdapat pada pelajaran kimia yang dianggap sebagai mata pelajaran yang susah, sehingga dibutuhkan model pembelajaran kooperatif yang sesuai dalam memahami pokok bahasan hidrokarbon. Penelitian ini bertujuan untuk melihat perbandingan hasil belajar antara model pembelajaran kooperatif tipe Make a Match dengan tipe Two Stay Two Stray pada pokok bahasan hidrokarbon. Penelitin ini dilakukan di SMK Tamansiswa Kisaran, Sumatera Utara. Teknik pengambilan sampel menggunakan sampling jenuh (sensus), dimana sampel terdiri dari 2 kelas, yaitu kelas XII-1 menerapkan Make a Match dan kelas XII-2 menerapkan Two Stay Two Stray dengan masing-masing kelas berjumlah 20 siswa. Data dikumpulkan dari pre-tes dan post tes, kemudian di analisis secara statistik menggunakan uji t. Hasil penelitian menunjukkan bahwa nilai rata-rata hasil belajar kognitif pada pretest-posttest di kelas eksperimen 1 sebesar 27,5 dan 77,0, sedangkan nilai rata-rata hasil belajar kognitif pada pre test-post test di kelas eskperimen 2 sebesar 25,3 dan 77,8. Uji t dilakukan dengan teknik independent sampel test diperoleh nilai signifikan (2-tailed) adalah sebesar 0,406<2,026, artinya H_0 diterima dan Ha ditolak. Berdasarkan hasil penelitian dapat disimpulkan bahwa tidak terdapat perbedaan yang signifikan hasil belajar siswa yang diajarkan dengan model*

pembelajaran kooperatif tipe Make a Match dengan tipe Two Stay Two Stray pada pokok bahasan hidrokarbon.

Kata kunci: hasil belajar, make a match, model pembelajaran, two stay two stray.

▪ INTRODUCTION

Hydrocarbon compounds are the simplest carbon compounds cause only composed of hydrogen atoms and carbon atoms. In daily life, we are faced with many hydrocarbon compounds, such as plastics, gasoline, kerosene, natural gas, and others. To date, more than 2 million hydrocarbon compounds have been known. To make it easier to study so many hydrocarbon compounds, experts classify hydrocarbons based on the number of other C atoms bonded to one C atom in the carbon chain and the arrangement of the carbon atoms in the molecule (Wilkes and Schwarzbauer, 2010).

Chemistry as part of science is taught for a more specific aim, especially to provide students with the knowledge, comprehension, and a number of skills required to go to higher levels and evolve science and technology (Suardana et al, 2018). Therefore, learning should emphasize providing direct learning experiences through the use and development of process skills and scientific attitudes as well as one of the fields of knowledge that must be mastered (Kamamia et al, 2014). However, in reality chemistry lessons are still considered difficult subjects, because chemistry lessons require comprehensive understanding, explanation and exposure cause misconceptions for students (Suwandy and Irhasyuarna, 2017).

This fact also appears based on the results of initial observations made to teachers in the field of chemistry studies at SMK Tamansiswa Kisaran showing that student activity in learning chemistry in the classroom is still low, this is due to the learning method set by the teacher is not appropriate to familiarize students more actively in teaching and learning process and develop social skills. Chemistry learning still relies a lot on the teacher where students are still just following lessons in class, namely by listening to lectures and working on questions given by the teacher without being accompanied by a desire and interest in learning to understand the material taught by the teacher. It has an impact on the low mean student learning outcomes. From the results of the semester exams at class XII students of SMK Tamansiswa, the students' formative mean range is 67, which is considered still less than the standard of completeness, which is 75. This makes chemistry one of the most important subjects to pay attention.

Application of the cooperative learning model is one of the solutions to overcome various learning problems (Ahriani, 2014), such as the *Make a Match* (*MM*) and the *Two Stay Two Stray* (*TSTS*). The *Make a Match* learning model is students looking for a mate while learning about a topic or concept (Rusman, 2011). The advantage of the *MM* is creates an active and pleasure learning situation, where the situation of enthusiasm will increase in the learning process and increase learning motivation because the learning material presented attracts students' attention (Lazim et al, 2018). Besides, the *Two Stay Two Stray* learning model is a pair of students stay in the group and a pair of other students come to another group (Nurhusain, 2017). The advantages of the *TSTS* is the emergence of an active learning situation and does not make students bored in

learning, there is good cooperation between students and a sense of responsibility for the assigned tasks and maintains class order (Maulana and Hidayati, 2017).

Teachers as educators have an important role in the transfer of knowledge to learners in learning. Learning will be a problem if students only memorize concepts without understanding the intent and content of material delivered, including chemistry (Riza, 2017). The learning models not all suitable for conveying materials in chemistry. If a comparison of two learning models on a chemical material is made, it will show an increase in different learning outcomes (Rushiana and Iryani, 2021). Therefore, it is necessary to pay attention to the suitability between the learning model and the material being taught (Ilmawati and Suherman, 2016). The results of Manik's (2012) research on the application of the *MM*, stated that the increase in learning outcomes in the *MM* type of cooperative learning model using handout media on the subject of hydrocarbons in class X SMA Methodist-8 Medan was 30.43%. While the results of research related to the *TSTS* conducted by Nola (2012), stated that the percentage of students is increasing who achieved learning mastery from 16.67% to 44.44% through the *TSTS* on the structure of atoms subjects, the periodic system, and chemical bonds.

Based on the description above, this study aims to compare the learning outcomes between two types of cooperative learning models, namely, Make a Match and Two Stay Two Stray on hydrocarbons materials.

▪ METHOD

This research has been carried out at SMK Tamansiswa Kisaran, Sumatera Utara and that is experimental research, involving two classes consisting of experimental class 1 and experimental class 2. For experimental class 1, learning is given using the *Make a Match* (MM), while experimental class 2 given learning with the *Two Stay Two Stray* (TSTS).

Research Implementation Stage

The research implementation stage begins with determining the 2 classes that will be the samples in the study. Then, conducting pre-test the two sample classes, aims to test the homogeneity and normality of the two sample groups, as well as to get an idea of the students' initial abilities before being given different treatment on the material to be discussed, by giving X treatment (*Make A Match*) in experimental class 1 and Y treatment in experimental class 2 (*Two Stay Two Stray*). In this study, maintained that the conditions of the two sample groups are the same, the teacher who teaches, the books used except for one thing, namely treatment X (*Make A Match*) in experimental class 1 and treatment Y (*Two Stay Two Stray*) in experimental class 2. After the learning/treatment process in the experimental class 1 was completed, a post-test was conducted to measure the achievements of the experimental class 1 (T1) and in the experimental class 2 (T2).

Data Processing Stage

The data processing stage begins with tabulating the pre-test and post-test score/value data and then the difference in learning outcomes get in the experimental class 1 and experimental class 2 before and after doing (pre test-post test). After that, test the statistical data analysis, normality and homogeneity test by calculating the mean change in student learning outcomes of each class. Then compare the changes/increases

or decreases in the scores obtained in the Experiment I class and the Experiment II class by applying the t-test and finally drawing conclusions.

Data analysis technique

The data analysis technique using the t-test can be done the fulfill prerequisite tests below:

Normality Test

This test aims to see whether the sample is normally distributed or not. The test used is the Chi Square test (X^2). The steps taken include determine the wavelength and the interval of class lenght, arrange the data into the helper table, find f_0 of the interval and fh (expected frequency), calculate the value, determine the significance level (α) which is 0.05, find the chi squared table with degree of freedom = (n-1), where n = many classes, and then compare the calculated chi square value with the table chi square. Finnaly, determine the criteria if $X^2_{count} < X^2_{table}$ then normally distributed.

Homogeneity Test

To calculate whether the two variations of the two samples are homogeny the homogeneity test is carried out at a significance level of 5% with the following formula:

$$F = \frac{\text{largest variance}}{V\text{smallest variance}}$$

The calculated F was consulted with the frequency distribution table F(α = 0.05). If $F_{count} < F_{table}$, then the two sample groups come from a homogeny population.

Hypothesis Test

Hypothesis test used to test whether the truth can be accepted or rejected by using the two-part t-test. The formula used is:

$$t_{hitung} = \frac{X_1 - X_2}{S\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}}$$

$$S^2 = \frac{(n_1-1)S_1^2+(n_2-1)S_2^2}{n_1+n_2-2}$$

Note :

$\bar{X}_1$ = The mean increase in learning outcomes from the experimental class group 1

$\bar{X}_2$ = The mean increase in learning outcomes from the experimental class group 2

n1 = Number of students in the experimental class 1

n2 = Number of students in the experimental class 2

S1 = Variance of the experimental class group 1

S2 = Variance of the experimental class group 2

The t-test is carried out with the criteria if $t_{count} > t_{table}$, then Ha is accepted at the level = 0.05 with df = n1+ n2 - 2. The applicable test criteria are the critical area is at: t_{table} - t 1/2 and t_{table} t 1/2 , then Ha is accepted.

Percentage of Improved Learning Outcomes

According to Meltzer, the percent increase in learning outcomes can be calculated using the g factor formula (normalized gain score). The g factor formula is used to determine the acquisition of student learning outcomes. The percentage increase in learning outcomes can be immediately found from the mean gain value of all students in each class.

The g factor formula used is as follows:

$$g = \frac{post\ tes\ value - pre\ test\ value}{\max value - pre\ test\ value}$$

According Hake (1998), the gain criteria as follows:

>0.7 = high gain
0.3 – 0.7 = medium gain
<0.3 = low gain

▪ RESULT AND DISCUSSION

Before starting the lesson, the students in both the experimental class 1 and the experimental class 2 were asked to do a pre-test which aims to determine the students' initial abilities. Then the students in the experimental class 1 were taught using the *Make a Match* type cooperative learning model, while the experimental class 2 were taught using the *Two Stay Two Stray* type cooperative learning model.

Student Pre-Test Data

The test instrument used was 20 questions of multiple choice. The pre-test was given before the experimental class sample group 1 with the implementation of the *Make a Match* and the experimental class 2 with the implementation of the *Two Stay Two Stray*. In summary, the results of the student pre-test can be seen in Table 1.

Table 1. Student Pre-Test Result Data

	Experimental 1	Experimental 2
Minimum value	5	5
Maximum value	45	40
Mean	27.5	25.3
Standard deviation	9.80	8.03

Based on Table 1, the mean pre-test score for the experimental class 1 with 20 students is 27.5 where the highest score is 45 and the lowest value is 5 and the standard deviation is 9.80, while the mean pre-test score for the experimental class 2 is the number of students. 20 is 25.2 where the highest value is 40 and the lowest value is 5 and the standard deviation is 8.03.

Student Post Test Data

The test instrument used was 20 questions of multiple choice. The post test was given after the experimental class sample group 1 by applying the *Make a Match* to the

experimental class 2 by applying the *Two Stay Two Stray*. In summary, the results of the student post test can be seen in Table 2.

Table 2. Student Post-Test Result Data

	Experimental 1	Experimental 2
Minimum value	60	65
Maximum value	90	90
Mean	77.0	77.8
Standard deviation	6.15	5.49

Based on Table 2, the mean post-test score for the experimental class 1 with 20 students is 77 where the highest score is 90 and the lowest score is 60 and the standard deviation is 6.13, while the mean post-test score for the experimental class 2 with 20 students is 77.78 where the highest value is 90 and the lowest value is 65 and the standard deviation is 5.49.

Based on the data analysis of learning outcomes in the study before being treated differently to the two sample classes, it was found that the mean student learning outcomes of experimental class 1 were 27.5 + 9.80 and after being given learning by applying the *Make a Match* obtained student learning outcomes 77 + 6.15. As for the experimental class 2 students before the treatment, the student's learning outcomes were 25.25 + 8.025 and after being given learning by applying the *Two Stay Two Stray*, the mean student learning outcomes of chemistry were 77.75 + 5.49.

Normality test

The normality test of the data was carried out by comparing the F_{count} with the F_{table}, namely the normality test of the data for the experimental group 1 and experiment 2 were said to be normal if $X^2_{count} < X^2_{table}$. The results of the data normality test in both experiments can be seen in Table 3.

Table 3. Normality Test of Pre-test and Post-test Data

Class	Data Source	X^2_{count}	X^2_{table}	α	Note
Experimental 1	Pre-tes	7.65	11.07	0.05	Normal
	Post-tes	6.27			Normal
Experimental 2	Pre-tes	6.27			Normal
	Post-tes	8.03			Normal

Based on Table 3 it can be concluded that:

1. Test the normality of data on student learning outcomes of experimental class 1 obtained X^2_{count} for pre-test 7.65 and X^2_{count} for post-test 6.27. By taking the significance level of = 0.05 and dk = 5 is 11.07, from the data it can be seen that the Chi Square value (X^2_{count}) < Chi Square value (X^2_{table}) it can be concluded that the data on student chemistry learning outcomes is normally distributed.
2. Test the normality of the data on student learning outcomes in experimental class 2 obtained X^2_{count} for pre-test 6.27 and X^2_{count} for post-test 8.03. By taking the significance level of = 0.05 and df = 5 is 11.07, from the data it can be seen that the Chi Square value (X^2_{count}) < Chi Square value (X^2_{table}) it can be concluded that the data on student chemistry learning outcomes is normally distributed.

Homogeneity Test

The results of the calculation for the homogeneity test of the data is to compare Fcount and Ftable, which is said to be homogeneous if $F_{count} < F_{table}$ at the significance level = 0.05. The results of the data homogeneity test in both experiments can be seen in Table 4.

Table 4. Sample Homogeneity Test

Data Source	Class	S^2	F_{count}	F_{table}	Note
Pre-Tes	Experimental 1	96.04	1.49	2.39	Homogeny
	Experimental 2	64.40			
Post-Tes	Experimental 1	37.894	1.25		Homogeny
	Experimental 2	30.197			

Based on the data in Table 4, the pre-test F_{count} = 1.49 while the post-test F_{count} = 1.25. Based on the table of values for the distribution of F with a significance level of = 0.05 and df the numerator 19 and df the denominator 19 ($F_{0.05}$)(19.19) the value of F_{table} = 2.39 (by interpolation). Because the value of $F_{count} < F_{table}$, it can be concluded that the pre-test and post-test of the two classes are homogeny.

Hypothesis Test

Once it is known that the data is normally distributed and homogeneous, it is possible to test the hypothesis by using a two-part t-test statistical test. Hypothesis test was conducted to determine whether the alternative hypothesis (Ha) was accepted or rejected. Hypothesis test was carried out at the significance level = 0.05 with the test criteria $t_{count} > t_{table}$. The results of hypothesis test can be seen in Table 5.

Table 5. Research Hypothesis Test

Class Data		T_{count}	T_{table}	Note
Experimental 1	Experimental 2			
$\bar{X}$ = 77	$\bar{X}$ = 77.75	0.406	2.026	Ho accepted, Ha rejected
SD = 6.155	SD = 5.495			
S^2 = 37.894	S^2 = 30.197			

The results of hypothesis test used a significance level of 5% (α = 0.05). The results of the hypothesis are obtained $t_{count} < t_{table}$ (0.406<2.026), so in this case Ho is accepted and rejects Ha. So, it can be concluded that there is no significant difference between student learning outcomes with the *Make a Match* and the *Two Stay Two Stray*.

Percentage of Improved Learning Outcomes

The results of the percentage increase in learning outcomes can be immediately found from the mean gain value of all students in each class can be seen in Table 6.

Table 6. Percentage of Improved Learning Outcomes

Class	Criteria	Note	G	Note
Experimental 1	G < 0.3 = Low 0,3 < G > 0.7= Medium G > 0.7 = High	Σg =13.60 $\Sigma \bar{g}$ = 0.680	68.0%	Medium
Experimental 2		Σg = 13.98 $\Sigma \bar{g}$ = 0.699	69.9%	Medium

Based on the data gain of student learning outcomes in experimental class 1 (*MM*) mean percentage increase of 68.0% was obtained while the experimental class 2 (*TSTS*) obtained mean percentage increase of 69.9%. Result research by Lin et al (2016), show that learning outcomes are a study of conceptual change and scientific achievement of students. Most of the studied factors were related to instruction and personal reasoning ability. In instruction, multiple instructional methods were generally integrated with the research, and "cooperative learning" and "conceptual conflict" were set up to be gaining the most attention. Besides, specific instructional methods were more often linked to specific science subjects. Tutors require knowledge about theories and strategies of conceptual change. The information should be more quickly available to expand the pedagogical content knowledge of teachers and help them effectively practice.

Based on the gain values gets a percentage increase in learning outcomes for each student by using the n-gain score. This result is confirmed by the results of the n-gain test which gets a mean gain of the experimental class 1 (0.68) and experimental class 2 (0.69) as a medium category. It can be concluded that the increase in student learning outcomes in experimental class 1 that use *Make a Match* and experimental class 2 that use *Two Stay Two Stray* is same. An increase in student learning outcomes is due to students who have not understood the hydrocarbon subject then understanding after obtaining the material so that the post-test value of students increases (Azizah and Budianto, 2019). Muttaqiin et al (2020) stated that to obtain a better concept mastery achievement, serious efforts are required during the learning process. According to Dahar (2011), concepts mastery is part of learning outcomes at the learning component. So, in the learning process students are needed to be able to understand concepts after learning activities.

The following graph of the percentage increase in student learning outcomes of experimental class 1 and 2 can be seen in Figure 1.

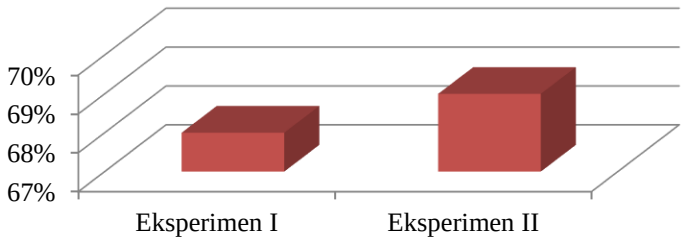

Figure 1. Graph of Learning Outcome Improvement

Based on the graph above, the percentage increase in student learning outcomes in experimental class 1 amounted to 20 students, which was 68% lower than the increase in student learning outcomes in experimental class 2, which amounted to 20 students, which was 69.9%.

Based on the research conducted at SMK Tamansiswa Kisaran, it can be said that the *Two Stay Two Stray* is preferred than the *Make a Match* on the subject of hydrocarbons. This is in line with student learning outcomes with the *Two Stay Two Stray* higher than student learning outcomes with the *Make a Match* on the subject of hydrocarbons, seen from the calculation of the increase in learning outcomes, but there is no significant difference between two cooperative learning models.

The results showed that the use of cooperative learning models, such as *Make a Match* and *Two Stay Two Stray* type can increase student learning outcomes by understanding, comprehensive explanations and exposure, so as not to cause misconceptions for student in hidrocarbon materials. In line with Apriakanti et al (2020), cooperative learning will encourage students to find and understand difficult concepts and be able to discuss these problems with their peers. Almost all research on cooperative learning shows that this learning can have a significant effect on the students' academic achievement. According to Elham et al (2019), many factors can be considered as the sources of students' misconceptions. Further, Muchtar and Harizal (2012) stated that prior experiences of the student, general use of some terms in scientific and non-scientific languages, not consideration of attention to the terms used in the class, contexts, and figures in the textbooks, method of teaching, etc. are complete that affecting misunderstandings in the students.

▪ CONCLUSION

There is no significant difference in student learning outcomes with the MM type of cooperative learning model compared to the TSTS type of cooperative learning model. The increase in student learning outcomes with the MM and TSTS type of cooperative learning model was 68% and 69.9%, respectively.

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