Vol.13 (3), 2024, 139-147 DOI: 10.23960/jppk.v13.i3.32399
Jurnal Pendidikan dan Pembelajaran Kimia
e-ISSN: 2714-9595| p-ISSN 2302-1772
http://jurnal.fkip.unila.ac.id/index.php/JPK/index

Implementing the Cooperative Learning Model STAD (Student Teams Achievement Division) to Improve Student Motivation and Learning Outcomes in Stoichiometry

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Accepted: December 6th, 2024 Accepted: December 19th, 2024 Online Published:December 26th, 2024

Abstract: Implementation of Cooperative Learning Model STAD (Student Teams Achievement Division) Type to Improve Student Motivation and Learning Outcames in Stoichiometry Material. Stoichiometry is often considered challenging by students, as reflected in their low learning outcomes. This study aims to examine the impact of the Cooperative Learning model, specifically the STAD type, on students' motivation and learning outcomes in stoichiometry. The research utilized a quantitative method with a one group pretest-posttest design. Research instruments included a learning outcomes test and a motivation questionnaire. The findings revealed that this learning model significantly enhanced students' motivation and learning outcomes compared to conventional methods. Students in the experimental class demonstrated active participation in group activities and higher motivation, resulting in better academic performance. In conclusion, the implementation of the Cooperative Learning STAD type model effectively improves students' motivation and learning outcomes in stoichiometry.

Keywords: Cooperative Learning, Implementation, Learning Motivation, Learning Outcames, Stoichiometry

Abstrak: Penerapan Model Pembelajaran Cooperative Learning Tipe STAD (Student Teams Achievement Division) Untuk Meningkatkan Motivasi dan Hasil Belajar Siswa Pada Materi Stoikiometri. Materi stoikiometri sering dianggap sulit oleh siswa, sebagaimana ditunjukkan oleh hasil belajar yang rendah. Penelitian ini bertujuan untuk mengkaji pengaruh model pembelajaran Cooperative Learning tipe STAD terhadap motivasi dan hasil belajar siswa pada materi stoikiometri. Penelitian dilakukan dengan metode kuantitatif menggunakan desain pretest-posttest satu kelompok. Instrumen penelitian meliputi tes hasil belajar dan angket motivasi. Hasil penelitian menunjukkan bahwa model pembelajaran ini mampu meningkatkan motivasi dan hasil belajar siswa secara signifikan dibandingkan dengan model konvensional. Siswa pada kelas eksperimen menunjukkan partisipasi aktif dalam kelompok dan lebih termotivasi dalam belajar, yang berdampak pada perolehan hasil belajar yang lebih baik.

Kesimpulannya, penerapan model Cooperative Learning tipe STAD efektif dalam meningkatkan motivasi dan hasil belajar siswa pada materi stoikiometri.

Kata kunci: Cooperative Learning, Pengaruh, Motivasi Belajar, Hasil Belajar, Stoikiometri

▪ INTRODUCTION

Indonesia is one of the developing countries that is focusing on Development to achieve a developed country. In this effort, in addition to requiring natural resources, it also requires qualified human resources. One of the efforts made to create and improve the quality of human resources is through Education (Wapa et al., 2024).

Education is an effort to develop the human nature of individuals, with the main goal of educating about skills, values, and knowledge so that someone can achieve their optimal potential (Wahyuna & Chaer, 2020). According to Aprilyanti et al. (2024), education is a basic human need that allows individuals to develop and interact with the surrounding community. Education includes the process of learning about morals, knowledge, and skills that are passed down from generation to generation through teaching, observation, training, or research. In accordance with the purpose of National Education as stated in Law Number 20 of 2003 concerning the National Education System, namely, "Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have spiritual religious strength, intelligence, self-control, personality, noble morals, and the skills needed by themselves, society, nation and state" (Syahnaz et al., 2023).

Chemistry is one of the scientific materials studied in grade XI. Chemistry has many roles in life, especially stoichiometry which has an important role in the chemical industry (Yolanda & Juwitaningsih, 2024). Stoichiometry is one of the chemistry materials that focuses on discussing the concept of moles, empirical formulas, molecular formulas, limiting reagents and percent yields (Ramli et al., 2022). Based on the literature study that has been conducted, it states that stoichiometry material is still considered difficult by students (Evangelista et al., 2022; Mellyzar et al., 2022; Prasetyawati, 2021; Zakiyah et al., 2018). In line with the results of interviews that we conducted with chemistry teachers at SMAS Santo Yoseph, it was stated that there are still many students who experience difficulties in stoichiometry material as shown by their learning outcomes.

This is not without reason, as stated by Ahmad (2022) there are 3 factors that underlie students' difficulties in understanding stoichiometry material, including: 1) The teacher's teaching method using a learning model, 2) Lack of student interest in learning stoichiometry, and 3) lack of student effort to collect data during the learning process.

Success how to learn process in the highly dependent on the model applied. The application of learning models is an important key because it can helps facilitate the learning process so as to achieve optimal results and increase student learning motivation. If not right model, the learning process will not achieve maximum results and will not take place effectively and efficiently (Mahayuni et al., 2017; Wulandari, 2022).

In modern education, cooperative learning has become a major concern as a strategy to increase students' learning motivation. This approach encourages students to work together and interact, allowing them to learn from each other and provide support in achieving academic goals. Previous research has shown that cooperative learning can

increase students' learning motivation by creating a supportive atmosphere, fostering greater responsibility, and deepening understanding through group discussions (Lathifa et al., 2024)**.** One popular model is the STAD (Student Teams Achievement Division) Cooperative Learning model. This model is considered effective in improving students' ability to explore information and activate learning activities (Sriana & Sujarwo, 2022).

According to Slavin in research Kurniati (2022), the STAD cooperative learning model is considered one of the simplest, and is a model that is often used in the context of cooperative learning. Slavin explains that in cooperative learning with the STAD model, students are placed in groups based on varying academic abilities, including high, medium, and low levels of success, as well as variations in gender, race, ethnicity, or other social groups.

• METHOD

This research was conducted at SMA Swasta Santo Yoseph Medan. The population in this study were all 2 classes of class XI IPA. Both classes were used as research samples, where Class XI 1 was the experimental class and class XI 2 was the control class. In this study, the One Group Pretest-Postest Design was used. Silitonga (2013) stated that in the pretest-posttest control group design, two groups of samples were used which were taken randomly from the population (Ma et al., 2019). This study aims todetermine the effect of the cooperative learning model type (STAD) on student motivation and learning outcomes in stoichiometry material.

Data on learning motivation and learning outcomes of students in the experimental and control classes will be subjected to statistical tests to determine whether the research hypothesis is accepted or rejected. The tests carried out first are the normality and homogeneity tests, then continued with the t-test (Silitonga, 2013). To determine the increase in student learning outcomes, the N-gain test is used with the following formula.

$$N - gain = \frac{Posttest\ score - Pretest\ Score}{Maximum\ Score - Pretest\ Score}$$

(Hamsir, 2017)

The normalized gain level is interpreted by stating the increase in student learning outcomes, with the following criteria:

Table 1. N-gain Criteria

$N - gain > 0{,}7$	High
$0{,}4 \leq N - gain \geq 0{,}7$	Medium
$N - gain < 0{,}3$	Low

(Sukarelawan et al., 2024)

• RESULT AND DISCUSSION

Student Learning Outcomes

Based on the trials conducted in the experimental class using the STAD Type Cooperative Learning model and the control class using the conventional model, the pretest and posttest data for the two sample classes were obtained, which are presented in Table 2 below.

Table 2. Learning Outcome Data

Class	*Pre-Test*	*Post-Test*

	$\bar{X}$	S	S^2	$\bar{X}$	S	S^2
Experiment	34.14	9,813	96.30	83.85	6,651	44.24
Control	32.5	11.16	124.62	76.47	7,127	50.80

$\bar{X} = median\,; S = standard\ deviation;\ S^2 = Variance$

Based on table 2, a graph of the average pretest and posttest values of the two sample groups can be depicted, as shown in figure 1 below.

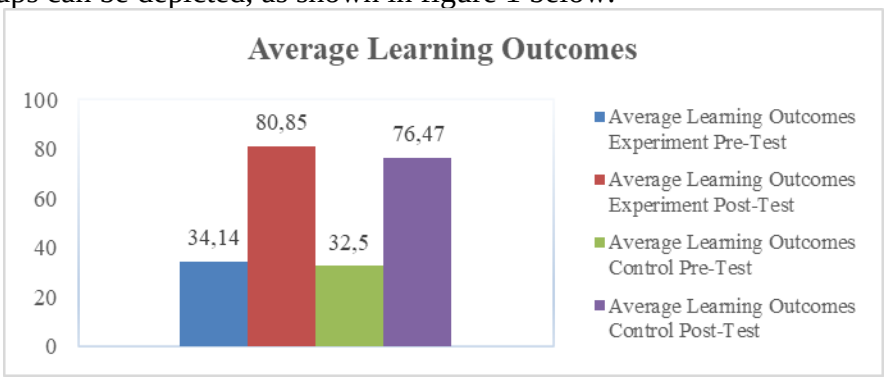

Figure 1. Average Learning Outcomes graph

Student Learning Motivation

Based on the calculations that have been carried out on the learning motivation data of students in the two sample classes obtained after special treatment was carried out on each class, the average value of learning motivation for the two sample classes was obtained, which is presented in Figure 2 below.

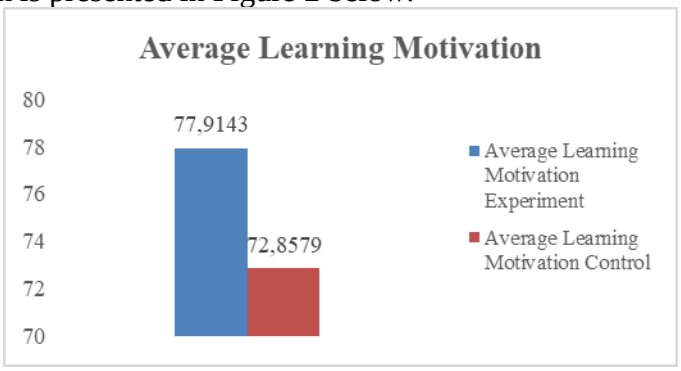

Figure 2. Average Learning Motivation graph

Normality Test

Normality test using Chi-Square test, learning motivation data and learning outcomes are checked whether they are normally distributed or not. Based on the results of the calculation of the normality of learning motivation data and student learning outcomes, at a significance level of 0.05, it shows that both sample groups have average data, or $X^2_{Count} < X^2_{Table}$, (Silitonga, 2013)**.** Thus, it can be said that the learning motivation data and learning outcomes of the two sample groups are normally distributed, as shown in table 3 below.

Table 3. Normality Test of Learning Motivation and Learning Outcomes Data

No	Data	X^2_{count}	X^2_{table}	Conclusion
1	Experimental class learning outcomes	5.31	11.07	Normal
2	Control class learning outcomes	9.11	11.07	Normal
3	Experimental class learning motivation	10.06	11.07	Normal

4	Control class learning motivation	7.88	11.07	Normal

Based on the table it can be seen that:

1. The experimental class learning outcome data is normally distributed. To find out is to use the significance level $\alpha = 0{,}05$and dk 5 of 11.07. Then the value $X^2_{count}$is compared with the value X^2_{table}. If $X^2_{count} < X^2_{table}$, then the data is normally distributed. The data obtained is 5.31 < 11.07, thus the experimental class learning outcome data is normally distributed.
2. The learning outcome data of the control class is normally distributed. To find out is to use the level of significance $\alpha = 0{,}05$ and dk 5 of 11.07. Then the value $X^2_{count}$is compared with the value X^2_{table}. If $X^2_{count} < X^2_{table}$, then the data is normally distributed. The data obtained is 9.11 < 11.07, thus the learning outcome data of the control class is normally distributed.
3. data of the experimental class is normally distributed. To find out is to use the level of significance $\alpha = 0{,}05$and dk 5 of 11.07. Then the value $X^2_{count}$is compared with the value X^2_{table}. If $X^2_{count} < X^2_{table}$, then the data is normally distributed. The data obtained is 10.06 < 11.07, thus the learning motivation data of the experimental class is normally distributed.
4. The learning motivation data of the control class is normally distributed. To find out is to use the level of significance $\alpha = 0{,}05$and dk 5 of 11.07. Then the value $X^2_{count}$is compared with the value X^2_{table}. If $X^2_{count} < X^2_{table}$, then the data is normally distributed. The data obtained is 7.88 <11.07, thus the learning motivation data of the control class is normally distributed.

Homogeneity Test

By using the formula F_{count}operated using Microsoft Excel 2021, a test was carried out on the learning motivation data and learning outcomes of the two sample classes whether they are homogeneous or not. The data is said to be homogeneous if, $F_{count} < F_{table}$. The significance level used is $\alpha = 0{,}05$, Where the numerator dk is 35 and the denominator dk is 34, a value of 1.74 is obtained F_{table}. Based on the results of the calculations carried out on the learning motivation data and student learning outcomes, the values F_{count} are presented in table 4 below.

Table 4. Homogeneity Test of Student Motivation and Learning Outcomes Data

Data	Class	S^2	F_{count}	F_{table}	Conclusion
Learning outcomes	Experiment Control	32.47 50.80	1.56	1.74	Homogeneous
Learning Motivation	Experiment Control	35.78 30.25	1.18	1.74	Homogeneous

$S^2 = Variance$,$F_{table} = db\ (n_1 - 1), (n_2 - 1)(\alpha = 0{,}05)$

Learning Outcome Improvement Test (N-gain Test)

The learning outcome improvement test was conducted on the pretest and posttest scores of each sample class. Based on the calculation of the N-gain test, the data presented in Figure 3 below was obtained.

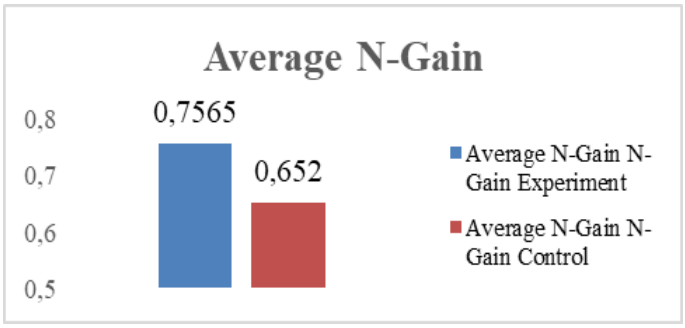

Figure 3. Average N-Gain graph

Based on Figure 3, it can be seen that there is an increase in the learning outcomes of the experimental class taught using the STAD Type Cooperative Learning model of 0.7565 with a high increase category, while in the control class taught using the conventional model there was an increase of 0.652 with a moderate increase category.

Hypothesis Testing

Hypothesis testing is tested using a one-tailed t-test (right-tailed test) which is carried out after the prerequisite test is met (data is normal and homogeneous). Hypothesis testing is intended to determine whether the hypothesis is accepted or rejected. The hypothesis is accepted if the value $t_{count} > t_{table}$. In this study, there are 2 hypotheses to be tested, including:

1. The learning motivation of students taught using the STAD Cooperative Learning model on stoichiometry material is higher than the learning motivation of students taught using the conventional model.
2. The learning outcomes of students taught using the STAD Cooperative Learning model on stoichiometry material are higher than the learning outcomes of students taught using the conventional model.

Based on the calculations that have been carried out on the data on learning motivation and student learning outcomes, the values obtained t_{count} are presented in the table below.

Table 5. Test of Hypothesis 1 and Hypothesis 2

Data	Class	t_{count}	t_{table}	Conclusion
Learning Motivation	Experiment Control	3.65	1,668	Ho is rejected and Ha is accepted
Learning outcomes	Experiment Control	4.76	1,668	Ho is rejected and Ha is accepted

$t_{table} = 1{,}668, \alpha = 0{,}05$

In table 5 it can be seen that the values $t_{count} > t_{table}$ in both research hypotheses. So it can be concluded that the motivation and learning outcomes of students who are taught using the STAD Type Cooperative Learning model on stoichiometry material are higher than the motivation and learning outcomes of students who are taught using the conventional model.

Discussion

Based on the data analysis that has been done, the average *pre-test score* in the experimental class was 34.14 while in the control class it was 32.5. The average *post-test score* was 83.85 while in the control class it was 76.47. Based on the results obtained, the learning outcomes taught with the STAD Type *Cooperative Learning*

learning model in the experimental class were higher than the learning outcomes of students taught with the conventional learning model in the control class on stoichiometry material. The increase in learning outcomes that occurred in the experimental class was due to the influence of the treatment, namely the application of the STAD Type *Cooperative Learning learning model* in the experimental class. In addition, statistical tests also showed normal and homogeneous data, meaning that there was no range that was too far between the learning outcome values obtained in the experimental class as seen from the standard deviation and variance of the data.

In addition to learning outcomes, the next data obtained is student learning motivation. The average value of motivation in the experimental class was 77.91 while in the control class it was only 72.85. Based on the results obtained, it can be seen that the learning motivation of students taught with the STAD Type *Cooperative Learning model* is greater than the learning motivation of students taught with the conventional model on stoichiometry material.

Cooperative learning model can increase student activity in the learning process so that students become motivated in participating in learning so that it will affect the learning outcomes obtained. In the application of the STAD *Cooperative Learning learning model* , it provides opportunities for students to actively participate in group discussions. Another thing that encourages increased student motivation is because in the application of this model there is a syntax that requires teachers to give *rewards* to students or groups who get the best grades, so that with this *reward* each group tries to get high grades to get the *reward* .

▪ CONCLUSION

Based on the results of the research, it can be concluded that the learning motivation of students taught using the STAD Type Cooperative Learning model in the experimental class (77.91) is significantly higher compared to the motivation of students taught with the conventional learning model in the control class (72.85) on stoichiometry material. Additionally, the learning outcomes of students in the experimental class, who were taught using the STAD Type Cooperative Learning model (83.85), are also higher than those of students in the control class (76.47), who were taught with the conventional learning model on stoichiometry material.

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