

Application of the Stad Type Cooperative Learning Model to Student Learning Outcomes in Subjects Electric Motor Installation

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ABSTRACT

This research was conducted to examine how the implementation of the Student Teams Achievement Division (STAD) cooperative learning model influences students' achievement in the Electric Motor Installation subject for Grade XI of Electrical Power Installation Engineering at State Vocational high school 1 Bukittinggi. The low learning outcomes are caused by differences in students' understanding abilities—some grasp the material quickly, while others struggle to comprehend the concepts of electric motors and installation practices. To address this issue, the STAD model was applied, emphasizing collaboration in heterogeneous groups to help each other and understand the material thoroughly. This experimental research used a *Pre-Experimental Design* with a *One Group Pretest-Posttest Design*. The subjects were 32 Grade XI TITL students at State Vocational high school 1 Bukittinggi in the 2025/2026 academic year. Data were collected through learning outcome tests (pretest and posttest), practical skill assessments, and observation sheets. The data were analyzed using descriptive analysis, normalized gain scores, and classical mastery learning. The results showed an increase in average learning outcomes after implementing the STAD model. Observation results also indicated improved student activity and practical skills, categorized as good to very good. Therefore, the STAD cooperative learning model is effective in improving student learning outcomes in the Electric Motor Installation subject for Grade XI TITL at Vocational high school 1 Bukittinggi.

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A. INTRODUCTION

The advancement of science and technology requires the world of education to continue to adapt to produce highly competitive and high-quality human resources [1]. In addition to being a tool to maximize personal potential, education is essential in shaping intelligent and moral people [2]. The implementation of the Independent Learning Curriculum, which prioritizes learning flexibility and competency strengthening, is one of the innovations in the field of education today [3]. The effectiveness of the learning process can be reflected in student learning outcomes that show the level of educational success [4]. In the learning process, students play an active role as subjects involved in interaction with teachers, learning resources, and the classroom environment [4]. Schools, as formal educational institutions, play an important role in facilitating students to develop their abilities and potential. Vocational high school is one of the educational pathways that equips students with the academic and practical skills necessary for their field of specialization [5].

One of the schools that has adopted the Independent Curriculum is Vocational High School 1 Bukittinggi, which implements the Electrical Power Installation Engineering (TITL) expertise program. The subject of Electric Motor Installation (IML) is the core part of this program, which plays a role in fostering students' theoretical understanding as well as practical skills in the field of electricity. Based on the results of observations made during the Educational Field Practice (PLK) activities from July to December of the 2024/2025 school year at Vocational high school 1 Bukittinggi, it was found that there were differences in students' ability to understand the material. Of the 33 students in grade XI TITL 2 who were observed, some students were able to understand the material quickly, while others still had difficulty in understanding the basic concepts of electric motors, recognizing components, and reading installation diagrams.

Table 1. Learning Completeness of Grade XI TITL 2 Students

No	Classes	Number of Students	Student Learning Completeness				Class average
			KKTP \geq 75		KKTP $<$ 75		
			Number of Students	%	Number of Students	%	
1	XI TITL 2	33	14	42,42	19	57,58	69,45

Source: Subject Teacher

Based on the data in Table 1, it can be seen that 57.58% of the students have not achieved the completeness of learning outcomes, where the average class obtained is 69.45. This condition demands a more creative and effective update of learning strategies, so that the improvement of student learning outcomes can occur evenly. During the implementation of PLK, teachers are still dominant in using the model *Project Based Learning* (PjBL). Although it provides practical experience, its application is not optimal because it does not fully accommodate the differences in students' abilities, so students with slow comprehension tend to be left behind. As a solution, a learning model is needed that can encourage cooperation and mutual help between students. One form of cooperative learning that can be used as an alternative in teaching and learning activities is *Student Teams Achievement Division* (STAD) because it prioritizes cooperative learning in diverse groups to achieve common goals [6], [7]. This model has shown its effectiveness in improving student learning outcomes, encouraging motivation, and building positive social attitudes among students [8], [9], [10]. Therefore, the purpose of this study is to find out the extent to which the STAD-type cooperative learning approach has an impact on the learning outcomes of students in the subject of Electric Motor Installation at Vocational high school 1 Bukittinggi.

B. METHODS

2.1 Research Design

This study uses a quantitative method with a pre-experimental approach, namely *One Group Pretest-Posttest Design*. Students carry out an initial test (pretest) before treatment and a final test (posttest) after the application of the *Student Teams Achievement Division (STAD)* type cooperative learning model. This design is used to assess the extent of improvement and completeness of students' learning after the implementation of the model.

The following table shows the above design:

Table 2. Research Design

<i>Pretest</i>	<i>Treatment</i>	<i>Posttest</i>
O ₁	X	O ₂

Description :

- O₁ = Pretest results obtained before the implementation of learning with a cooperative model of the *Student Teams Achievement Division (STAD)* type
- O₂ = Posttest results obtained after the implementation of learning with a cooperative model of the *Student Teams Achievement Division (STAD)* type
- X = Implementation of the *Student Teams Achievement Division (STAD)* type cooperative learning model

2.2 Research Procedure

2.2.1 Preparation Stage

- 1) Preparing a research permit
- 2) Defining a research schedule
- 3) Preparing the subject material to be researched
- 4) Preparing the learning media to be used
- 5) Compiling Pre-Test and Post-Test questions
- 6) Validate the research instruments that have been made

2.2.2 Implementation Stage

The STAD cooperative learning model is used to organize learning activities in experimental classrooms. The implementation steps are arranged using the STAD syntax, which can be seen in the following table.

Table 3. Syntax of the STAD Type Cooperative Learning Model

No	Activities	Teacher's Activities	Student Activities
1	Conveying Stad's Goals and Motivation	Explain the learning objectives of STAD and the importance of cooperation in groups. Convey STAD procedures and provide motivation to learn.	Listen to the teacher's explanations, understand the learning objectives of the STAD, and be motivated to be actively involved in the group.
2	Information Presentation	Deliver material through lectures, demonstrations, or media such as jobsheets. Answer questions and provide additional clarification when needed.	Listen to the material, record important information, and ask questions if you don't understand.
3	Group Work	Form heterogeneous groups (4–5 people), guide group discussions, monitor student cooperation and understanding.	Discuss in groups, complete tasks together, help each other understand the material.
4	Individual Quizzes and Progress Scores	Compile and distribute individual quizzes/ <i>posttests</i> , monitor implementation, and calculate student	Take the quiz individually without the help of a friend. Trying to show understanding of the material independently.

		development scores based on <i>pretest</i> – <i>posttest</i> .	
5	Team Awards and Reflections	Reward the best group, facilitate reflection sessions and provide feedback on the learning process and outcomes.	Receive awards, express opinions and experiences during learning, and receive feedback from teachers.

2.2.3 Completion Stage

- 1) Data analysis was carried out by comparing pretest and posttest scores to determine the improvement in student learning outcomes
- 2) Conclusions are compiled based on the interpretation of the results of the data analysis obtained

2.3 Research Instruments

In this study, two types of data collection instruments were used, namely assessment of students' abilities and attitudes and learning outcome tests (*Pretest* and *posttest*). In class XI of TITL Vocational High School 1 Bukittinggi, *Pretest* function to determine the initial level of students' understanding of the Electric Motor Installation material, while *posttest* intended to assess their final abilities after the implementation of the Student Teams Achievement Division (STAD) type cooperative learning model. In addition, assessments of students' skills and attitudes are carried out during practical activities to get an idea of their ability to apply the concepts that have been learned. Prior to the implementation of the research, all instruments used, both pretest and posttest questions and skill and attitude assessment sheets, have gone through a validation process by competent experts in their respective fields to ensure the accuracy and feasibility of the instrument as a research measuring tool.

Pretest and Posttest Test

2.3.1 Validity Test

A question must have substantial support for the overall score and be able to gauge what should be tested in order to be considered valid. Use the following formula, which Suharsimi proposed in [1] To determine the validity of the test:

$$Y_{pbi} = \frac{M_p - M_t}{s_t} \sqrt{\frac{p}{q}}$$

Description :

Y_{pbi} = The biserial point correlation coefficient, used to determine the relationship between the total score and the correct answer to a question item

M_p = Average scores and subjects who answered the questions of various items that were searched for validity

$$\left(\frac{\text{The number of scores of student who answered correctly}}{\text{Number of students who answered correctly}} \right)$$

M_t = Average question score

$$\left(\frac{\text{The number of scores of student who answered correctly}}{\text{Number of students who answered correctly}} \right)$$

s_t = Standard deviation (standard deviation)

p = Proportion of students who gave correct answers

q = Proportion of students who give wrong answers

q = 1-p

Source : [1]

Furthermore, at a significance level of 5%, the price of Y_{pbi} is converted to the price of the Y table. A question item is considered valid if Y_{pbi} is greater than Y table, and invalid if Y_{pbi} is smaller

than Y table. Twenty-five of the thirty questions in the test question instrument *Pre-tests* considered valid, while five questions were considered invalid based on the results of the validity test analysis.

2.3.2 Reliability Test

The consistency of an instrument when used on the same subject is known as reliability. When using tests on the same topic, reliability testing is essential. If an instrument consistently delivers results, it can be classified as an instrument that has a high level of reliability.

$$r_{11} = \left(\frac{n}{n-1} \right) \left(\frac{S^2 - \sum pq}{S^2} \right)$$

The reliability test was carried out to determine the level of consistency of the research instrument. The formula used refers to the reliability coefficient (r_{11}) with the following information (Source:[11])

Description:

r_{11} : The reliability coefficient of the overall test used.

P : The percentage or proportion of students who answered the question item correctly.

q : The proportion of students who give wrong answers, provided $q = 1 - p$.

$\sum pq$: The total result of multiplication between the values of p and q in each question item.

n : The number of question items in the test.

S : The standard deviation from the overall total score of the participants.

The reliability classification can be seen in the table below.

Yes	Coefficient Range	Reliability Level
1	0,81 – 1,00	Very high
2	0,61 – 0,80	Height
3	0,41 – 0,60	Medium
4	0,21 – 0,40	Low
5	0,00 – 0,20	Very low

[11]

The results of the reliability analysis of the test instrument showed that *Pretest* and *posttest* The results of the reliability value are obtained *Pretest* of 1.02 and is included in the very high category. Similar results were also found in *posttest* with a reliability value of 1.02 which is classified as very high.

2.3.3 Index of Difficulty Questions

The purpose of the difficulty level test is to assess the quality of the question items in the research instrument. A question is considered good if the level of difficulty is in the medium category, which is not too easy or too difficult for students. According to Suharsimi [12], "The difficulty index is a number that indicates the level of complexity or ease of a problem." The following formulas used in finding the level of difficulty are;

$$p = \frac{B}{J_s}$$

Description:

P = Index value that indicates the level of difficulty of a question item.

B = The number of students who have successfully answered the question items correctly.

J_s = The total number of participants who took the test.

The criterion is that the more difficult the problem, the lower the difficulty index. On the other hand, the easier it is, the higher the difficulty index.

Difficulty Index	Category
0,00 – 0,30	Difficult
0,31 – 0,70	Medium
0,71- 1,00	Easy

[11]

Judging from the difficulty index of questions using Microsoft Excel, there are test results showing that 22 pretest questions are classified as easy, 7 questions are classified as moderate, while 1 question is at a high difficulty level. For the posttest results, there are 16 questions in the medium category and 14 questions in the easy category.

2.3.4 Different Tests

The method of assessing the quality of each question item is known as the term "differentiating power". To determine which students need to improve their comprehension, this indicator is used to distinguish between students who have mastered the topic and students who have not fully understood it [13]. The differentiating power test is used to determine the ability of the question item in identifying the difference between high-ability and low-ability students. The calculation of the differentiating power is based on several variables with the following information. Sources: Arikunto (2012) namely:

$$D = \frac{B_A}{J_A} - \frac{B_B}{J_B} = P_A - P_B$$

Description:

- D = A value that indicates the level of differentiating power of each question item.
- YES = The number of students included in the upper group.
- JB = The number of students who are included in the lower group.
- TO = The number of participants from the top group who answered correctly.
- BB = The number of participants from the lower group who answered correctly.
- PA = The proportion of participants in the top group who gave the correct answer.
- PB = The proportion of participants in the lower group who gave the correct answer.

Table 6. Classification Level of Differentiating Power of Question Items

Value Range D	Quality Level of Question Items
0,00 - 0,20	Very low/poor
0,21 - 0,40	Enough
0,41 - 0,70	Good
0,71 - 1,00	Excellent

[11]

Using Microsoft Excel, the difference of 30 test questions *Pre-test* calculated. From this number, the results of the differentiating power analysis were obtained, it was obtained that 5 questions were classified as very low, 16 items were sufficient, and 9 items were good. Meanwhile, of the 30 posttest questions analyzed, there were 3 items in the low category, 13 items were sufficient, 12 items were good, and 2 items were very good.

Attitude Assessment Instrument

The method used to measure aspects of students' attitudes was carried out through observation using the attitude scale assessment rubric. Application of cooperative learning model *Student Teams Achievement Division* (STAD) is used to assess students' attitudes in the learning process. The assessment instrument in the form of attitude rubrics is prepared as a tool to evaluate affective aspects during learning activities. This assessment includes four main aspects, namely cooperation, responsibility, communication, and interest in learning. The assessment criteria refer to the attitude assessment guidelines from the Ministry of Education and Culture[14] As presented in Table 6 :

Table 7. Attitude Assessment Instrument Grid

No	Character Value	Assessment Indicators	Predicate	Score
1	Cooperation	Demonstrate the ability to work together with all group members	SB	4
		Demonstrate the ability to work together with some group members	B	3

		Demonstrate the ability to work with a single group member	C	2
		Not showing the ability to cooperate with any group member	K	1
2	Responsibilities	Completing tasks with correct results and submitted on time	SB	4
		Completed the task correctly, but the collection was not done on time	B	3
		Tasks are completed on time, but the results are still not correct	C	2
		Tasks are done with inappropriate results and are collected not according to the specified time	K	1
3	Communication	Able to interact with all students in the class	SB	4
		Able to interact with some students in the class	B	3
		Be able to interact with one student in the class	C	2
		Unable to interact with any students in the classroom	K	1
4	Interest	Showing a high curiosity towards the entire learning material	SB	4
		Show sufficient curiosity about the material being studied	B	3
		Showing interest in only a small portion of the learning material	C	2
		Not showing interest or curiosity in the subject matter	K	1

Description :

SB shows categories : Excellent

B indicates category : Good

C indicates the category : Enough

K indicates category : Less

Skills Assessment Instrument

Through observation and the application of the skill scale evaluation rubric, students' skills are measured. This assessment rubric is used as an instrument to assess students' abilities while participating in the Electric Motor Installation learning process with the application of a cooperative type model *Student Teams Achievement Division (CITY)*. The student's ability to install a motor with alternating controls in accordance with safety regulations and work procedures is the main subject of the skill assessment. The design of the skill assessment instrument grid looks like this:

Table 8. Skills Assessment Instrument Grid

No	Assessment Aspects	Assessment Techniques	Instruments	Score
1	Students prepare complete alternating circuit equipment	Work demonstrations	Performance evaluation rubric	Less = 1 Enough = 2 Good = 3 Very Good = 4
2	Students use practical equipment according to their functions and pay attention to K3			
3	Students make work plans correctly			
4	Learners complete alternating circuits correctly			
5	Students are able to apply alternating series			

- 6 Students pay attention to the neatness of alternating networks
- 7 Students complete the practice assignment according to the specified time

2.4 Data Analysis Techniques

2.4.1 Data Description

Descriptive analysis is used as a method to interpret and present research results so that they can be understood more clearly and informatively. This technique presents information systematically based on the average results obtained in the field. Through this analysis, researchers can find out the mean, median, and mode values with the help of Microsoft Excel as a data processing tool.

2.4.2 Data Analysis

N-Gain Score Analysis is used as a technique to compare results *Pretest* and *posttest* to measure the improvement of students' understanding. Analysis of the improvement of student learning outcomes before and after the implementation of the cooperative learning model *Student Teams Achievement Division* (STAD) is described by the normalized N-Gain test (g). An important influence on improving student comprehension is shown by a positive N-Gain score. Here is the calculation formula:

$$\text{Gain ternormalisasi } (g) = \frac{\text{Skor Posttest} - \text{Skor Pretest}}{\text{Skor Ideal} - \text{Skor Pretest}}$$

Based on the results of the calculation of the improvement in learning outcomes, the *N-Gain* then interpreted using certain criteria. The categories of the level of improvement are presented below.

Table 9. N-Gain Value Classification Criteria

N-Gain Value	Category
$g > 0.7$	Height
$0.3 \leq g \leq 0.7$	Medium
$g < 0.3$	Low

[15]

2.4.3 Learning Completeness

To determine the level of learning completeness that meets the Minimum Completeness Criteria (KKTP) 75, the analysis of the completeness of student learning outcomes is carried out based on the posttest scores obtained by students. If at least 85% of the students in a class have met the criteria for individual completeness, learning is generally considered to have achieved classical completeness[16]. The calculation of the completeness of learning outcomes is carried out using the following formula:

$$\% \text{ Ketuntasan Klasikal} = \frac{\text{Jumlah Peserta Didik yang Tuntas}}{\text{Jumlah Peserta Didik}} \times 100\%$$

2.4.4 Attitude competence

Using the attitude evaluation rubric in learning the STAD cooperative model, an observation of students' attitude competencies was carried out during the learning process of Electric Motor Installation. The following formula is then used to assess the observational data:

$$K = \frac{Sa}{Sm} \times 100\%$$

Description :

K = Skill score

Sa = Score obtained

Sm = Maximum score

The assessment of attitude and skill competencies refers to the guidelines from the Ministry of Education and Culture:[14]) The classification criteria for such assessments can be seen in the following table.

Table 10. Classification of Attitude Assessment

No.	Value Range	Predicate	Description of Criteria
1.	85 – 100	A	Excellent
2.	70 - 84	B	Good
3.	55 - 69	C	Enough
4.	≤ 54	D	Less

(Source: Ministry of Education and Culture:[14])

2.4.5 Skill competencies

The analysis of students' skill abilities is calculated using the following formula:

$$K = \frac{Sa}{Sm} \times 100\%$$

Description :

K = Learner's skill score

Sa = The number of grades obtained by the learner

Sm = Achievable max score

The determination of the level of competence of practical skills is described in the following table.

Table 11. Classification of Student Skills Assessment Results

No.	Value Range	Predicate	Description of Criteria
1.	85 – 100	A	Excellent
2.	70 - 84	B	Good
3.	55 - 69	C	Enough
4.	≤ 54	D	Less

(Source : [17])

C. RESULTS OF RESEARCH AND DISCUSSION

3.1 Exposure of Research Results

3.1.1 Data Description Description

Pretest

Based on the results of the analysis of pretest data, it was obtained that of the 32 students who took the test, the highest score reached 88 and the lowest score was 36. The results of statistical calculations show a mean value of 67.75, a median of 70, a mode of 76, and a standard deviation of 13.00.

Table 12. Pretest frequency distribution

Class intervals	Frequency	%F
36-45	2	6
46-55	4	13
56-65	7	22
66-75	6	19
76-85	12	38
86-95	1	3
Quantity	32	100%

Based on the table, the highest score frequency is in the interval of 76-85 with an average of 67.75, still below the KKTP 75. Of the 32 students, 19 students have not completed and only 13 students have achieved complete learning.

Posttest

Based on the analysis of student *pretest* data , the highest score data was obtained of 96 and the lowest score of 60. The number of students who took the test was 32 people. With statistical

calculations, the mean = 80.87, median = 84, mode = 84, and the standard deviation of 8.60 were obtained.

Table 13. Posttest frequency distribution

Class intervals	Frequency	%F
60-67	2	6
68-74	5	16
75-81	8	25
82-88	11	34
89-95	4	13
94-100	2	6
Quantity	32	100%

Based on the table, the highest score frequency is in the interval of 82–88 with 11 students. Only 7 students whose scores were below the KKTP, showing that the level of achievement of learning objectives increased compared to *the previous* pretest results.

3.1.2 Data Analysis

Improved Learning Outcomes

Obtained an average N-Gain Score (40.52). This means that on average, students in grade XI TITL 2 have increased after being given treatment. The students' N-Gain score reached 0.406, which was in the medium category.

Learning Completeness

As many as 25 (78%) of the 32 students in class XI TITL 2 obtained higher scores from the KKTP, while 7 (22%) students have not completed the test. Based on the findings of the study, the improvement of student learning outcomes in the subject of Electric Motor Installation can be attributed to the application of the STAD cooperative learning method.

3.1.3 Attitude Competencies

From the results of the evaluation of the attitude of grade XI TITL students at Vocational high school 1 Bukittinggi, 12 students (37.5%) were in the very good category, 16 students (50%) were in the good category, and 4 students (12.5%) were in the fair category. Traditionally, the majority of students (87.5%) are in the good to very good category, while attitude competence is close to 100%. This shows that the improvement of students' attitude competencies is positive through the use of a STAD-type cooperative learning model.

3.1.4 Skill Competencies

From the results of the skill assessment of grade XI TITL 2 students at Vocational high school 1 Bukittinggi, 12 students (38%) obtained an A grade, 18 students (56%) a B grade, and 2 students (6%) a C grade.

3.2 Discussion

The STAD-type cooperative learning model in the subject of Electric Motor Installation at Vocational high school 1 Bukittinggi was able to increase student learning outcomes to the medium category, as shown by an average N-Gain value of 0.406. Before the implementation of this model, most students had not achieved KKTP. After the implementation of STAD, learning completeness increased to 78%, with 25 students completing and 7 students (22%) incomplete, demonstrating the effectiveness of STAD in improving learning outcomes.

The results of this study are in line with previous studies. [17] found that the STAD model was effective in improving student learning outcomes and activities in the subject of Electric Motor Installation (90% learning completion, 95.89% activity). Similar findings were put forward by [8] and [9] which emphasizes that STAD-type cooperative learning can improve students' knowledge and skills through group cooperation. Thus, the STAD model has proven to be effective in improving the

learning outcomes of Vocational high school students, especially in subjects that require mastery of concepts and practices. The use of the STAD model affects the development of attitudes and skills competencies in addition to improving cognitive learning outcomes. The competence of the students' classical attitude reached 100%, according to the assessment results, with 12.5% adequate, 37.5% very good, and 50% good. Students' skill competencies, on the other hand, reached 94%, with 56% good and 38% excellent. These findings show that students grow more engaged, responsible, and able to collaborate in productive groups. This conclusion is consistent with the findings of the [10] and [6], which suggests that the STAD model fosters positive social attitudes including empathy, cooperation, and group responsibility in addition to improving cognitive learning outcomes.

Although the study's findings showed a significant improvement, 22% of students still lacked mastery of learning. Differences in students' basic skills, inactivity of some group members, and lack of time to implement cooperative learning are some of the contributing factors. To ensure fairer learning outcomes, students who are still struggling need additional help or remedial learning. By paying attention to all factors, the application of the STAD model has been proven to improve student learning outcomes in the fields of knowledge, abilities, and attitudes. Because it can encourage a collaborative, dynamic, and relevant learning environment, this model deserves to be adopted more widely in Vocational High Schools (SMK), particularly in practical topics such as Electric Motor Installation. Further research is recommended to examine more deeply the influence of the STAD model on student motivation and creativity, as well as its application in cooperation with the industrial world to be more aligned with the needs of work competencies.

D. CONCLUSION

The application of the Student Teams Achievement Division (STAD) type cooperative learning model in the subject of Electric Motor Installation at Vocational high school 1 Bukittinggi has been proven to improve student learning outcomes. The application of this model is carried out through several stages, namely the delivery of learning objectives, the presentation of materials, heterogeneous group work, individual quizzes, and the awarding of awards to groups. The results showed that the average posttest score of 80.87 students was higher than the pretest score, with a learning completeness rate of 78%. In addition, the competence of students' attitudes and skills also showed good results with the majority of students obtaining good to very good predicates. These findings are in line with previous research that states that the STAD learning model is effective in improving learning outcomes, cooperation, and student involvement in the learning process. The success of the application of the STAD model in this study is influenced by the cooperation in groups, interaction between students, and the existence of individual responsibility in completing tasks. However, in its implementation, there are still limitations, such as differences in students' initial abilities and limited learning time that can affect the group discussion process. Therefore, the application of the STAD model can be an alternative learning model that is effective in improving student learning outcomes, especially in subjects that require an understanding of concepts and practical skills such as Electric Motor Installation.

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