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Article

Statistics Analysis the Effect of DiSTAD Learning Model on the Critical Thinking Skill and Learning Motivation

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Abstract. This study aims to determine the statistical analysis of the influence of the DiSTAD learning model on critical thinking skills, learning motivation, critical thinking skills and learning motivation. Data analysis using descriptive analysis and inferential analysis. The techniques used in data collection are test and non-test. The test technique is used to determine critical thinking skills and non-test techniques (quesioner) are used to determine the learning motivation of students. The results show that DiSTAD learning model gives a significantly positive effect to the critical thinking skills and it is shown by the output value of the t-test (5,529) (significance < 0.05). DiSTAD learning model gives a significantly positive effect to the student learning motivation, and it is shown by the output value of the t-test (5,531) (significance<0.05). The implementation of DiSTAD learning model gives a significantly more positive effect to the critical thinking skills and student learning motivation, and it is shown by the output value of the F-test (34,040) (significance < 0.05).

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1. Introduction

Education has always been the talk of every country in the world, this is because through education a nation can develop and progress [1]. Science learning in the 21st century is faced with the relevance of science and technology to the needs and demands of society [2]. With science learning, it is expected that students can be directed to the learning experience of designing and creating a work [3]. One-way knowledge transfer causes students to be bored and have difficulty understanding physics lessons [4]. The learning process requires a good reciprocal relationship between teachers and students, so that learning objectives can be carried out properly [5]. Ideally, other aspects of learning outside the curriculum should also be considered, namely psychic and physical activities. Among them are student motivation and critical thinking skills [6].

According to [7] one of the concepts adapted in the curriculum is the concept of a scientific approach which includes several learning models. One of the goals of applying the scientific approach in the learning process is the development of students' higher order thinking [8]. The learning models recommended by the 2013 Curriculum are project-based learning, problem-based learning, discovery learning, and guided inquiry. The application of this learning model is expected to develop students' skills, especially students' thinking skills, creativity, and critical thinking. According to [9] students' critical thinking skills are very important in the 21st century. In addition, [9] revealed that, the results of the 2013 survey showed that the implementation of learning strategies had not provided opportunities for students to train their critical thinking skills optimally.

According to [10] critical thinking is perceived in terms of skills/ability and disposition. Most of the participating teachers agreed that critical analysis helps students to apply theory/material critically. Critical thinking skills are not innate from birth, but appear when trained/applied through the learning process [11]. The critical thinking is one of the skills that was developed [12]. According to [13] the importance of developing critical thinking skills provides provisions for students to be able to draw logical conclusions through the process of gathering information in accordance with certain rules of science. In everyday life, humans need higher order thinking skills (HOTS), and critical thinking skills are one of the skills needed in it [14]. Critical thinking skills are important to be stimulated through planned learning, where students are able to express reasons that support the assumptions or conclusions obtained [15].

In addition to thinking skills that need to be improved, students' learning motivation also needs to be improved. Learning motivation is a mediator between stimuli and reactions. In other words, learning motivation is students' individual opinion about affairs, and students will present different knowledge acquisition needs because of differences in opinion [16]. The teaching method chosen according to the topic of the lesson to be presented with the right teaching method applied will help the success of the learning objectives. Teachers play an important role in the learning process. Teachers must have the competence to enable students [17].

One of the learning models that can help students think critically and increase learning motivation is the STAD (Student Teams Achievement Division) type of cooperative learning model. STAD emphasizes student interactions and activities to support each other in mastering lessons that have an impact on learning outcomes [18].

Research conducted by [19] shows that STAD can increase students' learning motivation. This can be seen in the results of the first cycle which shows that students' learning motivation increases in the moderate category (score 82.81). Furthermore, in cycle 2 the motivation to learn again increased to the high category (score 92.28). Research conducted by [20]shows that the use of problem-based cooperative learning models in science learning is effective in improving critical thinking and interpersonal intelligence of fifth graders. In addition, research conducted by [21] shows that the learning model STAD cooperative type in guided discovery on geometrical material is effective in terms of learning achievement, critical thinking skills, and self-confidence of class VIII junior high school students.

Based on interviews with teachers at SMP Satap Pong Meleng, it is known that the STAD (Student Teams Achievement Division) type of cooperative learning model has been applied in schools, especially in science lessons, but students' critical thinking skills and motivation are still very low. Teachers must think about how students can understand the concepts being taught by fostering motivation in students [22]. Therefore, there is a need for innovation in the science learning process, one of which is by modifying the STAD (Student Teams Achievement Division) learning model with the Discovery Learning model.

The discovery learning model is one of the constructivism-based models [23]. According to [24] Discovery Learning is a model that encourages the active involvement of each student to find concepts and principles independently or in groups through problems that have been given or prepared by the teacher. The teacher's task is to bridge or bridge students to find the concepts and principles that become the learning objectives. In the discovery learning model, learning activities are designed so that students can find concepts and principles through their mental processes [25]. In addition, the Discovery learning model is an effort to train students to have critical thinking skills [26].

Through discovery, students learn intensively by following the scientific investigation method under the supervision of the teacher. So learning is designed, supervised, and followed by investigative methods. Learning by using Discovery Learning has been widely studied before, and the results show that this learning can improve critical thinking skills. This can be seen in the research conducted by [27] which shows that the increase in students' mathematical critical thinking skills given the discovery learning model is higher than students who receive conventional learning. In addition, research conducted by [28] that there is a significant effect of discovery learning. In addition, research conducted by [29] showed that based on posttest data analysis, it was concluded that the DL method could improve the learning activities of class VII students of SMPN 6 Banda Aceh in the 2015-2016 school year.

Based on the advantages and disadvantages of the two learning models, the two learnings are combined into one learning model called the Discovery Student Team Achievement Division (DiSTAD). The purpose of combining these two learning models is to produce new syntax or learning steps that can guide and guide students in the process of discovering, investigating, and proving. The syntax of the DiSTAD learning model can be seen in the following table.

Table 1. Learning steps for DiSTAD

Learning Stage	Educator Activities	Student Activities
Stage 1 Educator Activities	Educators convey the objectives or indicators of the material to be studied (STAD). Educators divide students into heterogeneous groups (STAD). Educators ask questions about things related to the material being studied (Discovery Learning).	Students listen to the explanations given by the educator. Students form groups (STAD). Students answer questions given by educators, previously students are faced with things that cause confusion so that the desire to investigate on their own (Discovery Learning). Students listen and respond (STAD)

Learning Stage	Educator Activities	Student Activities
Phase II Teamwork (Group)	Educators convey and explain the material being studied (STAD).	
		Students find / identify problems found in distributed worksheets (Discovery Learning)
	Educators distribute worksheets and provide opportunities for students in their respective groups to identify things that are relevant to the subject matter (seen in the LKS), then one of them is selected to formulate a hypothesis (Discovery Learning).	
		Learners collect information related to learning topics (Discovery Learning).
	Educators provide the opportunity for each group to collect information related to learning to prove the hypothesis that has been formulated (Discovery Learning).	
Stage III Student Presentation		Students process data from the information obtained (Discovery Learning).
	Educators guide students in groups to process data / information (analyze data) (Discovery Learning).	Each group took turns presenting the results of their respective group discussions (STAD)
Stage IV Proof / Conclusion	Educators provide opportunities for students (representatives of each group) to present the results of group work (STAD)	Students carry out careful examinations to prove the hypothesis formulated (Discovery Learning)
Stage V Individual Quiz	Educators provide opportunities for students to find a concept, theory, or understanding through examples in life (Discovery Learning)	Students generalize the results or conclusions obtained (Discovery Learning)
Stage IV appreciation		Students take the given test / quiz (STAD)
	Educators draw conclusions that can be used as general principles by paying attention to the evidence that has been obtained (Discovery Learning)	
		Students pay tribute with applause for the best group (STAD)
	Educators provide individual tests / quizzes to each student (STAD)	
	Educators give awards to the group that gets the highest score or score as the best group (STAD)	

The DiSTAD component consists of a regular learning pattern starting from the delivery of learning objectives or indicators by educators, group division, group work, student presentations, proving hypotheses or conclusions, individual quizzes, and best group awards (see table 1). DiSTAD is learning that emphasizes the concept of discovery through group work. Working together in groups can have a positive influence on students.

If the previous research used one of these learning models (the cooperative type STAD or Discovery learning), then in this study the researchers combined the two learning models to see the extent of the influence of the DISTAD model on critical thinking skills and learning motivation. By considering the things of the two learning models and by looking at the results of the research that has been done, the researcher views that DiSTAD learning can have an influence on (1) critical thinking skills, (2) learning motivation, (3) critical thinking skills and learning motivation.

2. Methods

This research is a quasi experimental research. The design used in this research is "Nonequivalent pretest and posttest control group design". This research was conducted at SMP Satap Pong Meleng, Satarmese District, Manggarai Regency. The research was conducted in odd semesters starting from September 2019 to November 2019. The subjects in this study were class VIII which consisted of two study groups, namely class VIIIa and VIIIb, totaling 37 people. The sampling technique was carried out by means of saturated samples, because the number of students in each class did not exceed 30 people, so that all members of the population were sampled. This research procedure starts from September 2019 to early October 2019.
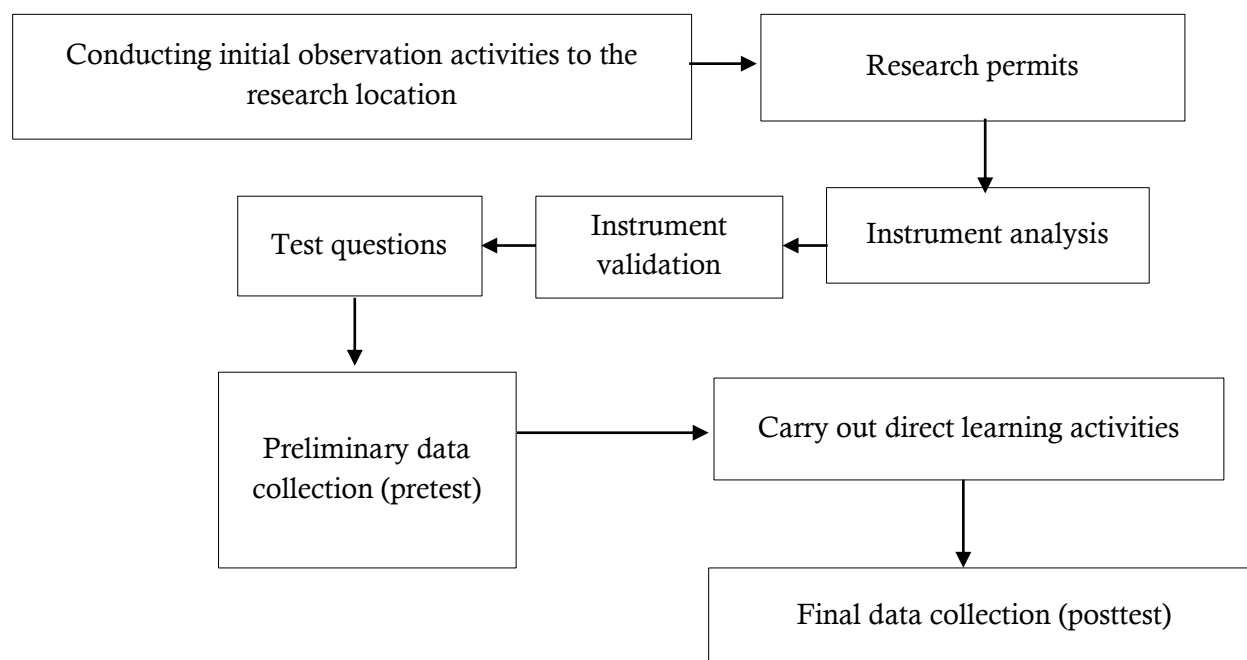

Figure 1. Research Procedure

From the flow chart, the research procedure can be described as follows: This research procedure started from September 2019 to early November 2019, With the following steps: In September to October 2019, researchers conducted (1) conducting initial observation activities to the research location, (2) research permission, (3) instrument analysis, (4) instrument validation, (5) test questions. October 2019 to November 2019: (1) initial data collection (pretest), (2) direct learning activities using the DiSTAD and STAD learning models, and (3) final data collection (posttest).

The syntax or steps in the learning process consist of six steps which are a combination of the Discovery and STAD learning steps. These steps consist of: educator activities, teamwork group, student presentation, conclusion/proof, individual quiz and appreciation.

The data collected were the results of tests of critical thinking skills and the results of observations (non-test) of students' learning motivation. The test aims to determine the critical thinking skills of students. The test was carried out twice, namely at the beginning of the treatment (pretest) and the end of the treatment (posttest). The research instrument in this study was in the form of a set of multiple choice questions with four answer choices which were arranged based on the subject indicators of the subject of science (motion material) and student learning motivation questionnaire sheets developed based on indicators. This learning motivation questionnaire is validated first before it is given to students, while the critical thinking ability test instrument before use must meet several requirements, namely the validity test, reliability test, the level of difficulty of the questions, and the distinguishing power of the questions.

The data analysis technique in this research is using descriptive analysis and inferential analysis. The data analysis technique was carried out with the help of the SPSS version 23 program. Descriptive analysis was used to present the data that had been obtained through the pretest and posttest. As for what is being analyzed is the physics learning process in terms of critical thinking skills and learning motivation of students, and it is said to be effective if the average score of each meets the KKM. In addition, to strengthen the research results, an N Gain analysis was also carried out. The criteria for the normalized average N Gain value can be seen in the following Table 2.

Table 2. Criteria for Normalized N-Gain Average

Normalized gain	Category
$g > 0,7$	High
$0,3 \leq g \geq 0,7$	Moderate
$g < 0,3$	Low

The test requirements used to analyze consist of the normality test and the homogeneity test. The data normality calculation was performed using the Shapiro-Wilk test method normality test through the SPSS 23 program. The sample data is said to be normal if the significance value is greater than 0.05 ($\rho > 0.05$). The calculation of the homogeneity test uses the Box's M test through the SPSS 23 program. The sample data is said to be homogeneous if the probability value is more than 0.05 ($\rho > 0.05$). The inferential analysis technique in this study uses the Independent t-test and Multivariate Analysis of Variance (MANOVA). The test criterion is Ho is accepted if tcount <ttable or if the p value> 0.05 at the significant level is greater than 0.05. After it is known that there is an effect of DiSTAD learning on critical thinking skills and learning motivation of students, the post hoct test is carried out. The posthoc test was used to find out more details about groups that were significantly different and groups that did not differ significantly in each multivariate pair (Stevens, 2009). The posthoc follow-up test in this study used the Tukey HSD test with the help of the SPSS 23 program.

3. Results and Discussion

This study aims to determine whether there is an effect of the Discovery Students Teams Achievement Divison (DiSTAD) learning model on the critical thinking skills and learning motivation of students at SMP. The DiSTAD learning steps are divided into two activities, namely activities of educators and activities of students. These two activities combine the Discovery Learning syntax and STAD learning syntax to produce six stages of learning.

The activity of educators in stage 1 is to convey the objectives or indicators of the material to be studied (STAD), then divide students into heterogeneous groups (STAD). Educators ask questions about things related to the material being studied (Discovery Learning). Educators convey and explain

the material being studied (STAD). For students in stage 1 the activity is that students listen to the explanations given by the educator, then form groups (STAD). Students answer questions given by educators, before students are faced with things that cause confusion so that there is a desire to investigate themselves (Discovery Learning), and then students listen and respond (STAD).

In stage 2, namely the team / group work stage, the activity of educators is that educators distribute worksheets and provide opportunities for students in their respective groups to identify things that are relevant to the subject matter (seen on the LKS), then one of them is selected to formulate the hypothesis (Discovery Learning), then gives the opportunity to each group to collect information related to learning to prove the hypothesis that has been formulated (Discovery Learning). After this, the educator guides students in groups to process data / information (analyze data) (Discovery Learning), while the activities of students are to find / identify problems found in the LKS that are distributed (Discovery Learning), collect information related to learning topics. (Discovery Learning), and processing data from the information obtained (Discovery Learning).

In stage 3, namely the presentation stage of students. At this stage the educator provides opportunities for students (representatives of each group) to present the results of group work (STAD), while students from each group take turns presenting the results of their respective group discussions (STAD).

In stage 4, namely the conclusion/proof stage, educators provide opportunities for students to find a concept, theory, or understanding through examples in life (Discovery Learning), and draw conclusions that can be used as general principles by paying attention to the evidence that has been obtained (Discovery Learning). Learning). While the activities of students carry out careful examinations to prove the formulated hypothesis (Discovery Learning), then generalize the results or conclusions obtained (Discovery Learning).

In stage 5 (individual quiz stage) Educators provide individual tests/quizzes to each student (STAD), while students take the given test/quiz (STAD). Meanwhile, the 6th stage (the last stage) is the award stage. At this stage, educators give awards to the group that gets the highest score or score as the best group (STAD), and students pay tribute with applause for the best group (STAD)

Based on pretest and postest, there is an increase in the critical thinking skills of students. This can be seen in Table 3.

Table 3. Average Score of Both Classes for Critical Thinking Ability

Class	Ability	Average
Control (STAD)	Early	7
	End	12.94
Experiment (DiSTAD)	Early	7.05
	End	15.21

In table 3 it can be seen that there is an increase in the average score of critical thinking in both classes. In the initial ability control class 7 and the final ability 12.94; while in the experimental class the initial ability is 7.05 and the end is 15.21. Meanwhile, learning motivation can be seen in Table 4.

Table 4. Average Score for Learning Motivation

Class	Ability	Average
Control (STAD)	Early	47.05
	End	83.28
Experiment (DiSTAD)	Early	36.84
	End	87.95

In table 4 it can be seen that the average score for learning motivation in the control class is 47.05 at the beginning and 83.28 at the end; while in the experimental class, the beginning was 36.84 and the end was 87.95.

The results of the analysis of the increase or N gain for the critical thinking skills and learning motivation of students can be seen in Table 5.

Table 5. Average Increase in N-Gain of Learning Outcomes

	Treatment			
	STAD		DiSTAD	
	n=18		n=19	
	CTA	ML	CTA	ML
Mean	0.46	0.67	0.63	0.81
Median	0.5	0.68	0.61	0.81
Variance	0.007	0.008	0.01	0.004
Std. Deviasi	0.08	0.87	0.1	0.59
Minimun	0.29	0.48	0.46	0.7
Maksimum	0.58	0.83	0.8	0.91

Based on Table 5, it can be seen that the difference between the mean N gain for the STAD and DiSTAD classes. for the mean value of critical thinking ability and learning motivation in the STAD class are 0.46 and 0.67, respectively; while in the DISTAD class the mean for critical thinking skills is 0.63 and learning motivation is 0.81.

This shows that critical thinking skills and learning motivation in the DISTAD class have increase more than in the STAD class. This can be seen in Figure 2.
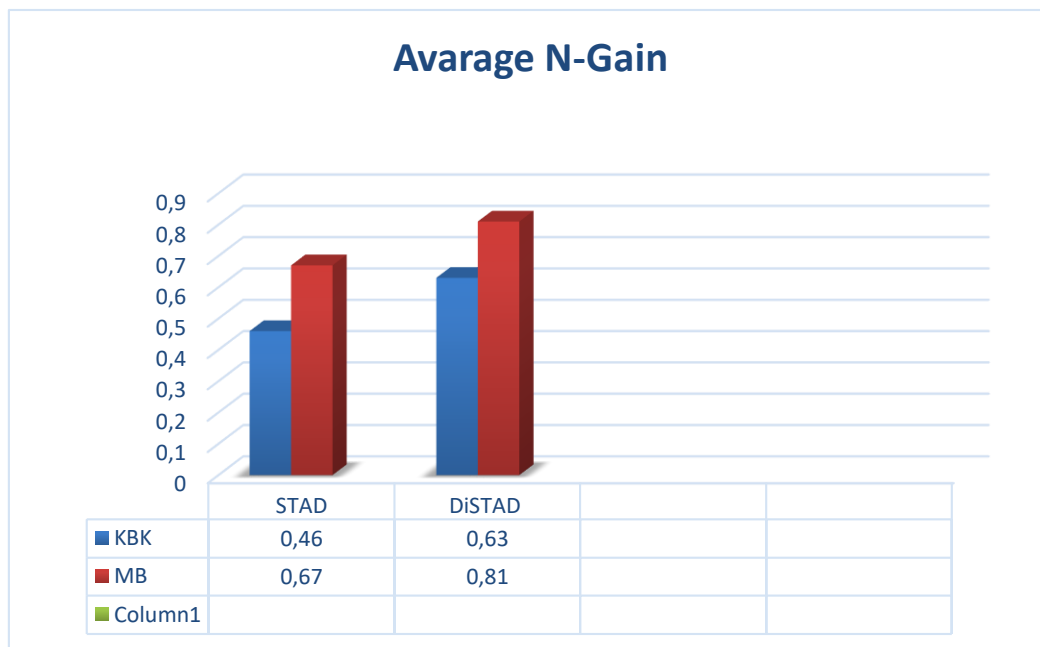

Avarage N-Gain

	STAD	DiSTAD
KBK	0,46	0,63
MB	0,67	0,81
Column1		

Figure 2. Average N gain STAD and DiSTAD Classes

From the figure, it can be concluded that the N gain for the DiSTAD class is higher than that for the STAD class. The normality test can be seen in Table 6.

Table 6. Normality Test Result

Variable	Shapiro-Wilk Treatment		
	STAD	DiSTAD	Desc.
CTA	0.103	0.367	Normal
LM	0.932	0.707	Normal

The STAD and DiSTAD homogenity test on critical thinking skills and learning motivation together using the Box's M test can be seen in Table 7.

Table 7. Homogenity Test Results

Box's Test of Equality of Covariance Matrices[a]	
Box's M	5.210
F	1.629
df1	3
df2	245669.391
Sig.	.180

From the results of Box's M table (in table 7), it can be seen that the significance value is 0.180; indicates that the significance value obtained is greater than $\alpha = 0.05$.

This shows that the variance covariance matrix of the STAD and DiSTAD classes is homogeneous. The full results of the independent t-test N gain analysis are presented in Table 8.

Table 8. Independent t-test Results for N gain

Class	Variable	t_{count}	Df	Sig	Desc.
STAD & DiSTAD	CTA	5.529	35	0,000	Influence
	LM	5.531	35	0,000	Influence

From the results of the independent t-test analysis for the STAD and DiSTAD classes (can see in table 8), the output value of tcount for critical thinking skills is 5.529 and the output value for learning motivation is 5.531. This shows that: (1) the significance value shows 0.00. This means that the significance value <0.05, so that Ho is rejected. Therefore, it can be concluded that the DiSTAD model has a positive and significant effect on students' critical thinking skills; (2) the significance value shows 0.00. This means that the significance value <0.05 so that Ho is rejected. Therefore, it can be concluded that the DiSTAD model has a positive and significant influence on students' learning motivation. The results of statistical analysis with the two-group Manova test can be seen in Table 9.

Table 9. Results of the Two Group Manova Test Statistic Difference Test

Multivariate Tests[a]						
Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.994	2704.158[b]	2.000	34.000	.000
	Wilks' Lambda	.006	2704.158[b]	2.000	34.000	.000
	Hotelling's Trace	159.068	2704.158[b]	2.000	34.000	.000
	Roy's Largest Root	159.068	2704.158[b]	2.000	34.000	.000
Kelas	Pillai's Trace	.667	34.040[b]	2.000	34.000	.000
	Wilks' Lambda	.333	34.040[b]	2.000	34.000	.000
	Hotelling's Trace	2.002	34.040[b]	2.000	34.000	.000
	Roy's Largest Root	2.002	34.040[b]	2.000	34.000	.000
a. Design: Intercept + Kelas						
b. Exact statistic						

From the results of the manova test analysis, it can be seen that the significance value is 0.00 and the F value is 2704.158 (on the Hotelling's Trace line), this shows that the DiSTAD learning model has an influence on critical thinking skills and learning motivation, so to see to what extent the significance of the influence of the DiSTAD learning model is tested. posthoc. The posthoc test used was the Tukey HSD posthoc test. The results of the Tukey HSD posthoc follow-up test analysis can be seen in Table 10.

Table 10. PostHoc Test

Treatment					
				95% Confidence Interval	
Dependent Variable	Treatment	Mean	Std. Error	Lower Bound	Upper Bound
CTA	STAD	12.944	.361	12.212	13.677
	DiSTAD	15.211	.351	14.497	15.924
LM	STAD	83.278	.795	81.663	84.892
	DiSTAD	87.947	.774	86.376	89.519

Based on the posthoc test in table 10, it can be seen that the critical thinking skills and learning motivation of students have increased significantly in movement material. This can be seen in the average value (mean of each variable). In the control class (STAD) for critical thinking skills of 12.94 while for learning motivation of 83.27. In the experimental class (DiSTAD) for critical thinking skills of 15.21 while for learning motivation 87.94.

The Effect of STAD and DiSTAD on Critical Thinking Ability. Students' critical thinking skills are measured using an instrument in the form of multiple choice questions totaling 20 questions that have been tested and validated beforehand so that they qualify as a measuring tool. From the results of the independent t-test analysis for the STAD and DiSTAD classes, it was found that the t-value output was 5.529 with a significance of 0.00 (significance <0.05), thus the STAD and DiSTAD hypotheses had an effect on critical thinking skills accepted.

The Influence of STAD and DiSTAD on Learning Motivation. In this study, learning motivation was measured using a non-test instrument in the form of a questionnaire. The questionnaire consisted of 25 statements divided into 3 indicators, namely (1) the desire and desire to succeed; (2) encouragement and kebutuhab in learning; and (3) there are hopes and dreams for the future. From the results of the independent t-test analysis for the STAD and DiSTAD classes, it was found that the t-value output was 5.531 with a significance of 0.00 (significance <0.05), thus the STAD hypothesis and guided inquiry had an effect on accepted learning motivation.

The Effect of STAD and DiSTAD on Critical Thinking Ability and Motivation to Learn Together. Testing with Manova was carried out to see the effect of STAD and DiSTAD learning on critical thinking skills and learning motivation of students together by analyzing the results of calculations with Hotteling's Trace. From the analysis, it was found that STAD and DiSTAD have F = 34.040 with a Hotteling's Trace significance value of 0.00, thus the STAD and DiSTAD hypotheses have an effect on critical thinking skills and learning motivation is accepted.

After it was known that the STAD and DiSTAD models had an influence on the ability to think critically and motivation to learn together, the test was continued by conducting further Tukey HSD Post Hoc tests. Tukey HSD Post Hoc further test was conducted to determine the effect of the STAD and DiSTAD models on critical thinking skills and learning motivation separately. From the results of the posthoc analysis, the output was obtained with a significance of 0.00 (significance <0.05), thus it can be concluded that STAD and DiSTAD have differences. The overall results of the research prove that STAD and DiSTAD have a positive and significant effect on critical thinking skills and learning motivation of students in learning physics material motion in class VIII SMP Satap Pong Meleng, Manggarai.

From the research results, it can be said that discovery learning and STAD learning models can be combined and have a positive influence on critical thinking skills and learning motivation. This is comparable to the research conducted by [29], which shows that Discovery Learning can increase students' active learning; also research conducted by [30] which states that STAD is effective on problem-solving abilities in students. In addition, research conducted by [31] states that the DiSTAD learning model has a significant and positive effect on students' learning motivation.

4. Conclusion

Based on the results of hypothesis testing and the discussion presented in this study, it can be concluded the DiSTAD learning model has a significant and positive effect on the critical thinking skills of students at SMP. The DiSTAD learning model has a significant and positive effect on the learning motivation of students at SMP. DiSTAD learning model has a significant and positive effect on the critical thinking skills and learning motivation of students at SMP. Suggestions that can be submitted are that educators can use the DiSTAD learning model as a form of innovation in learning to improve critical thinking skills and learning motivation or it can even be used to measure other variables, for example science process skill.

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