The Effectiveness of STAD Type Cooperative Learning Model on Students' Physics Comprehension Ability on Global Warming

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Abstract *- This research aims to determine the effectiveness of using the STAD (Student Teams Achievement Division) cooperative learning model on global warming. This type of research is pre-experimental research using a one-group pretest-post test design. The population of this research is class X students of SMA Negeri 7 Surakarta for the 2023/2024 academic year with a sample of class by cluster random sampling. Data collection techniques using multiple choice test to measure students' learning outcomes in understanding physics which were analyzed through normality test followed by an effectiveness test using the N–gain test. The research results show that the STAD (Student Teams Achievement Divisions) cooperative learning model influences students' understanding of physics on global warming. There is an increase in the average post-test score of 70.56 from the average pre-test score of 54.72 and the N-Gain value of 0.410 which is included in the medium category. Thus, the STAD cooperative learning model effectively enhances student achievement.*

Keywords*: STAD Cooperative Learning Model; Student Learning Outcomes; Effectiveness; Global Warming*

INTRODUCTION

Physics is a branch of science that generally includes a collection of knowledge, methods of thinking, and the process of investigation (Larasati & Yulianti, 2014). The accumulation of knowledge may be classified into the following categories: facts, concepts, principles, laws, theories, and models (Verawati et al., 2020). Learning is essentially a form of positive interaction between educators and students, as well as between fellow students (Rahayu, 2015). Therefore, physics learning is a branch of science that studies the physical properties of objects in nature, formulates them in mathematical form, and provides the results of its study to be analyzed or understood by humans for the good and welfare of mankind.

The role of the teacher in the classroom is ideally to support students in discovering facts, concepts, or principles themselves, not to control the entire learning process, so that physics learning becomes more qualified and meaningful (Hakim et al., 2018). The learning of physics will be more meaningful for students if they are actively involved in observing, understanding, and applying the facts, concepts, or principles of physics in their everyday lives. Accordingly, the implementation of an appropriate learning model is essential to facilitate students' active participation in the physics learning process (Rahayu, 2015).

In using a learning model, teachers must choose a model that can stimulate students' interest in learning actively and understanding the material being taught (Putra et al., 2019). In addition, the utilization of learning models also has an impact on the quality of learning through the activities designed and actions taken by learners (Aditya et al., 2022). Improving the quality of learning can be done through various strategies (Pratiwi et al., 2017), including the use of various methods, techniques, strategies, media, and learning models that are diverse according to the objectives and needs (Dewi et al., 2019). In addition, the improvement of the learning process must be adapted to the conditions of students (Puryadi et al., 2018). In using a learning model, teachers must choose a model that can stimulate students' interest in learning actively and understanding the material being taught (Putra et al., 2019).

According to Islamiah et al (2018), an effective learning process must provide students with opportunities to play an active role in each lesson. It is insufficient for the instructor to rely on a single pedagogical approach or method of instruction. By demonstrating the capacity to deploy a range of teaching models, the instructor can select the most appropriate model for the learning environment or a specific cohort of students (Hikmawati et al., 2014).

Based on observations at SMA Negeri 7 Surakarta, the learning process shows that students have not been actively involved. Students are not familiar with physics concepts that are abstract and unfamiliar to them. Learning in the classroom takes place monotonously, which reduces the meaning of physics learning and causes boredom and low student learning outcomes. Low student learning outcomes are also influenced by the lack of mastery of physics concepts and the lack of interaction between students, so that discussions are uneven and some students become passive and feel bored during physics learning. It can be reasonably deduced that students will gain a deeper comprehension of the subject matter if they are exposed to a variety of learning models. This is supported by the observation results, which indicate that the learning model employed by the instructor is largely unvaried and lacks diversity. The use of the discovery learning model as the sole approach at each session is not conducive to fostering a multifaceted understanding of the subject.

One of the learning models used is the STAD type cooperative model. Cooperative learning is characterized by tasks, goals, and rewards based on cooperation. This model not only helps students understand concepts, but also develops collaboration skills, critical thinking, and improves student learning outcomes (Sirajuddin, 2018). Cooperative learning creates a democratic learning atmosphere, providing opportunities for students to develop their full potential (Nugroho & Shodikin, 2018). One of the cooperative models used is STAD.

STAD consists of five main components: class presentations, teams, quizzes, individual improvement scores, and team recognition (Sunarti & Rachman, 2018)(Rumapea, 2018; Sunarti & Rachman, 2018). Learning with the STAD model supports students to be creative in the learning process and develop the ability to help each other with peers (Munawar, 2019). In addition, this model allows students to interact more intensively with their peers, making it easier to solve problems. STAD also supports two-way communication in the learning process (Istiqamah, 2019).

Global warming is one of the materials in Physics. Global warming is a worldwide issue, because its impact is felt by almost all inhabitants of the earth, not just Indonesia. The process of global warming occurs when the sun's heat is absorbed by the Earth's thin layer of atmosphere, then reflected back into space as infrared rays. However, the infrared radiation is trapped in the atmosphere, causing atmospheric temperatures to rise. This rise in global warming threatens the future of the earth. If not addressed immediately, the impacts could be very serious: polar ice caps will melt, sea levels will rise, heat waves will disrupt the climate, and major storms will devastate cities (Nik et al., 2022).

In light of the aforementioned description, the researcher puts forth a cooperative model for empirical testing in a high school setting, focusing on global warming-related content. The objective of this study is to evaluate the efficacy of the STAD cooperative learning model in enhancing students' comprehension of physics.

RESEARCH METHODS

The type of research is pre-experimental research. This research is a pre-experimental study that uses a One Group Pretest-Posttest Design (Sugiyono, 2019). The design of this study is presented in Table 1 below.

Table 1. Study Design

Pretest	Treatment	Post-test
$\boldsymbol{O_1}$	X_1	O_2

This study was conducted in the even semester of the 2023/2024 academic year at SMA Negeri 7 Surakarta located on Jalan Moh. Yamin No.79, Tipes, Serengan District, Surakarta City, Central Java with a population of class X students of SMA Negeri 7 Surakarta in the 2023/2024 academic year which has physics subjects. The sample taken, namely class X consisting of 36 students. The sample class was taken with cluster random sampling technique.

The instrument used in this study was a multiple-choice test question to measure students' physics knowledge ability. Before the test questions were given to the sample class, the questions were tested qualitatively and quantitatively. Qualitative analysis in the form of validation from the supervisor to determine whether it is relevant to the learning outcomes, appropriate to the material, construction, and language. Meanwhile, quantitative analysis to other students to determine the effectiveness of distractors, differentiating power, difficulty level, and reliability of questions.

Based on quantitative analysis, it is known that the effectiveness of question distractors is 9 questions in the very good category, 8 questions in the good category, 5 questions in the good enough category, 6 questions in the poor category, and 2 questions in the bad category. On the differentiating power of the question there are 16 questions in the good category, 3 questions in the good enough category, 11 questions in the bad category. At the level of difficulty there are 3 difficult category questions, 18 medium category questions, and 9 easy category questions. While the reliability of the question obtained the result of 0.717 so that it can be concluded that the questions to be used are valid.

Pretest data is used for hypothesis prerequisites for learning outcomes, researchers conduct hypothesis prerequisite tests, namely normality tests (equations), then researchers conduct hypothesis tests using *Microsoft Excel 2021* software, then researchers conduct balance tests. Hypothesis prerequisite tests are carried out to determine the statistical test to be used. The normality test was carried out using the Liliefors method. Balance test to find out if there is a difference between pre-test and post-test data. The balance test obtained a result of 0.0001 which means that there is a difference between the pretest and posttest data.

Furthermore, researchers analyzed the effectiveness of the treatment given using the N-gain test (Kolopita et al., 2022). The formula for calculating the N - gain score is as follows

$$N - gain = \frac{posttest\ score - pretest\ score}{skor\ maksimal - skor\ pretest} \quad (1)$$

The effectiveness criteria of the N-gain value are presented in Table 2.

Table 2. N-Gain Criteria

$N - gain$ Score	Criteria
$g > 0,7$	High
$0,3 \leq g \leq 0,7$	Medium
$g < 0,7$	Low

After conducting an effective analysis, the effect size can be calculated. Effect size is a measure of the practical significance of research results in the form of a measure of the magnitude of the correlation or difference, or the effect of a variable on another variable. Information about this effect size can also be used to compare the effects of one variable from studies using different measurement scales (Yustina et al., 2021). The following is the effect size formula according to Cohen for single group/one group:

$$\delta = \frac{\overline{X_t} - \overline{X_c}}{S_{pooted}} \times 100\% \qquad (2)$$

Description:
δ = effect size
$\overline{X_t}$ = average posttest score
$\overline{X_c}$ = average pretest score
S_{pooted} = standard deviation

Table 3. Interpretation of Effect Size for Single Group

Size	Interpretasi
0-0,20	Weak effect
0,21-0,50	Modest effect
0,51-1,00	Moderate effect
>1,00	Strong effect

RESULT AND DISCUSSION

Results

In this study, data were obtained from pre-test and post-test scores. The pre-test was conducted before the learning model treatment, while the post-test was conducted after the learning model treatment. The first step taken to analyze students' physics knowledge ability is the normality test. The normality test was carried out using the Liliefors method using the help of *Microsoft Excel 2021* software. If $L_{obs} < L_{tabel}$, so H_0 accepted so that the data is normally distributed, while if $L_{obs} > L_{tabel}$, so H_0 rejected so that the data is not normally distributed. The results of the normality test calculation are shown in Table 4 as follows

Table 4. Normality test

L_{hitung}	L_{tabel}	Conclusion
0,1269	0,1477	Normally distributed

Based on the normality test conducted, the results obtained that the experimental class I obtained a score of L_{hitung} less than L_{tabel}. So, the conclusion that can be obtained from the normality test hypothesis for class I is that both data on students' physics knowledge ability are normally distributed.

Table 5. Pretest Posttest Data

Data	Min	Max	Average	Standard Deviation
Pre-Test	30	80	54,72	16,82
Post-Test	30	100	70,56	18,20

Based on Table 5, it can be seen that the minimum score of the pre-test and post-test data is 30 and the maximum score of the post-test is 80 and increased in the post-test with a maximum score of 100. In addition, the mean score in the pre-test was 54.72 while the mean score in the post-test was 70.56. So, there is a difference in the average score of 15.86.

Tabel 6. N-Gain Score

N-Gain Criteria	Frequence	Percentage	N-Gain Average
High	4	11%	0,410
Medium	17	47%	
Low	15	42%	

Table 6 shows that in the experimental class consisting of 36 samples, there are 4 students who fall into the high criteria, 17 students fall into the medium criteria, and 15 students fall into the medium criteria. The average value of N - gain of experimental class II is 0.410 which is in the medium criteria. So, it can be concluded that the use of STAD (Student Teams Achievement Division) type cooperative learning model has moderate effectiveness in improving students’ physics understanding ability.

Furthermore, to determine the magnitude of the influence of the use of the STAD type cooperative learning model on the ability to understand physics, it can be analyzed using the effect size test. The results obtained after the calculation of the effect size are 1.75, it can be concluded that the test has a Strong effect criterion. Thus, the use of the STAD type cooperative learning model has a major influence on students' physics understanding abilities in the Global Warming in class X of SMA Negeri 7 Surakarta.

Discussion

Based on the researcher’s observation, the improvement of students’ physics understanding can occur because the STAD (Student Teams Achievement Divisions) cooperative learning model is able to increase students’ interest, ability, and motivation in improving physics learning outcomes. In accordance with research conducted by Verawati et al., (2020) which compared the STAD and Jigsaw cooperative learning models. The study found that the STAD cooperative learning model would produce better results than the Jigsaw cooperative learning model. This is because in the school where the research was conducted, the Jigsaw cooperative learning model was foreign to students, so teachers had to often explain the Jigsaw rules during teaching and learning activities, which resulted in less than optimal learning meeting time being used for discussion.

Meanwhile, the STAD cooperative learning model does not only focus on students’ mastery of academic skills and materials (Rasyid & Haris, 2015). This learning model can also train students to achieve social goals which in turn can have a positive impact on students’ academic achievement. The STAD cooperative learning model is characterized by a cooperative structure of tasks, goals, and rewards, which creates positive dependence among students, acceptance of individual differences, and development of group work skills (Amalia et al., 2016). This kind of condition makes a significant contribution in helping students who have difficulty learning concepts, so that every student in the class can achieve optimal learning results (Nur Syamsu et al., 2019).

The characteristics of the STAD learning model include; (1) Team learning, (2) Based on cooperative management, (3) Cooperative skills, (4) Requires a relatively long time, taking into account the three steps of STAD that drain time such as the presentation of material from the teacher, group work and individual tests/quizzes (Ernawita, 2017).

The syntax of the STAD learning model, namely forming groups of four members heterogeneously (mixed according to achievement, gender, ethnicity, etc.), the teacher presents the lesson, the teacher gives tasks to the group to be done by group members, the teacher gives quizzes or questions to all students, gives evaluation, conclusions, and the teacher presents the lesson (Sriana & Sujarwo, 2022).

The weaknesses in using the STAD (Student Teams Achievement Division) learning model include that some students are confused because they are not used to this kind of treatment, it takes longer time for students so that it is difficult to achieve curriculum targets, it takes longer time for teachers so that in general teachers do not want to use the STAD type cooperative learning model, requires special abilities of teachers so that not all teachers can do STAD cooperative learning, demands certain characteristics from students, such as a cooperative attitude (Wulandari, 2022).

CONCLUSION

Based on the results of the analysis and discussion, it can be concluded that the STAD (Student Teams Achievement Divisions) cooperative learning model influences students' understanding of physics on global warming. There is an increase in the average post-test score of 70.56 from the average pre-test score of 54.72 and the N-Gain value of 0.410 which is included in the medium category.

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