

## META ANALYSIS OF THE EFFECT OF COOPERATIVE LEARNING MODELS ON STUDENT LEARNING OUTCOMES PHYSICS

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### ABSTRACT

This research is a meta-analysis of the effect of cooperative learning models on learning outcomes of high school physics and junior high school science. The real condition found in the field is that the learning outcomes of physics and science students are still low. This study aims to analyze the effect of the cooperative learning model on student learning outcomes in high school physics and junior high school science subjects. The research method is a meta-analysis research. Data were collected and summarized from several articles. The sample used was 33 articles that have been published in various national and international journals. The articles are processed to calculate the effect size which is then grouped into four indicators, namely based on the level of the education unit, the unit of subject matter, the type of cooperative learning and the research area. The results of the study show that first, the cooperative learning model has a significant effect on high school education with a large effect category. Second, the cooperative learning model has a significant effect on the electric-magnetic unit of study in the category of major effects. Third, the cooperative learning model has a significant effect on the type of Team Games Tournaments cooperative learning in the very large effect category. Fourth, the cooperative learning model has a significant effect on South Kalimantan in the very large effect category

**Keywords:** Meta Analysis; Cooperative Model; Learning Outcomes.



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### I. INTRODUCTION

In the 21st century the progress of science and technology is very rapid. In the advancement of science and technology, qualified human resources are needed and are able to compete globally. The government makes policies in seeking adjustments to the education system in order to create quality human resources that are able to compete globally. One of the policies to improve the quality of education to suit current learning needs is curriculum development [1].

The 2013 curriculum is a form of improvement from the previous curriculum in Indonesia. In the 2013 curriculum, learning is no longer teacher-centered, however learning is more understudy focused, so that current learning is not one-way but more interactive [2]. The 2013 curriculum provides opportunities for students to have choices in developing their actual capacities and can improve their knowledge, skills and attitudes through the active role of students in the learning process at school [3]. This is also accompanied by the government's efforts to provide proper facilities and infrastructure at school [4]. All of this is done in order to achieve good learning, including in learning physics and science.

Physics learning is part of natural science (IPA) which concentrates on regular peculiarities experimentally, coherently, methodically and objectively involving scientific procedures and attitudes [5]. Natural science (IPA) itself is characterized as knowledge obtained through various information through experiments, observations, and deductions to convey clarification of a phenomenon truthful [6]. During physics and science learning students are introduced to materials, concepts and principles that are easy to find applications in everyday life. However, in learning at school, many students assume that learning physics and science is difficult and boring, causing low understudy learning results [7][8][9][10][11][12].

Another factor that causes low student learning outcomes is that learning still uses conventional methods where teacher-centered learning makes students passive/inactive in class [4][7][9][12][13][14][15]. In learning more students receive, record and memorize the concepts and formulas given by the teacher without first understanding [9][11][16][17].

In achieving normal learning objectives, appropriate learning strategies are needed to achieve ideal learning outcomes [18]. The learning strategy consists of approaches, models and learning methods. From several factors that cause low student learning outcomes, a solution is needed, namely student-centered learning. Student-centered learning can help in developing students' potential [19]. One of the learning methods that support the solution is the cooperative learning model.

Cooperative learning model is a learning model that can activate students in classroom learning because the learning is student-centered [7]. This learning model places students in small groups so that there is cooperation between students in studying the material provided by the teacher to achieve learning objectives [20]. This is based on the idea that students are easier to find and understand a concept if they discuss the problem with their friends [21]. This cooperative learning model is used as a solution to increase student learning activity and foster learning motivation, it is hoped that by applying this model student learning outcomes can increase [22].

The cooperative learning model has been widely applied in previous research. There are various types of cooperative learning models studied by previous researchers, namely the jigsaw type cooperative learning model [5][7][8][13][23][24][25], the student team achievement division [9] [20][26][27][28][29][30][31], cooperative learning model type number head together [4][10][14][32][33][34], learning model cooperative type of *teams games tournaments* [15][35][36][37][38][39] and cooperative learning model of *learning cycle* [11][12][16][17][40][41]). These studies have mixed results and conclusions. So it is necessary to re-analyze using the meta-analysis method.

Meta-analysis is a quantitative research method that uses data from past studies systematically to get accurate conclusions [42]. In this study, a meta-analysis will be carried out on 33 articles about the impact of cooperative learning models on students learning results in physics and science subjects. The articles will be analyzed by collecting statistical data from previous studies using *effect size* in each article. So the right method to conduct this research is to use the meta-analysis method.

For a number of reasons, meta-analysis study was selected as the research methodology. First, no previous research has conducted a meta-analysis of the cooperative learning model by making statistical conclusions. Second, this research can present the results of the research that has been done. Third, there is no research on the *summary effect size* of the effect of cooperative learning on understudy learning results in physics and science subjects. Fourth, the effect of cooperative learning on student understudy learning results in high school physics and junior high school science subjects is unknown, which has the highest *summary effect size* based on the level of education unit, subject matter unit, cooperative learning type and research area. Therefore, meta-analysis is a very appropriate research method to conclude various research results in a wide scope.

Considering the fundamental issues that have been outlined, the purpose of this article is to assess the effectiveness of the cooperative learning approach on understudy learning results in physics and science in terms of the level of education unit, subject matter unit, cooperative learning type and research area.

## II. METODE

Researchers employed a specific kind of meta-analysis in this investigation. Meta analysis is research which collects, processes, presents data that has been analyzed systematically and objectively, which the results will be used to solve problems by conducting an investigation into the earlier [43]. Meta-analysis is quantitative, because the calculations use numbers and statistics that use quantitative data analysis to examine prior research using a quantitative approach contained in the findings of earlier research. This meta-analysis study examines 33 articles published from 2012 to 2021.

From the many articles collected, 33 articles were selected as objects in this research. The selection of the 33 articles was based on the following criteria: (1) The selected articles were articles on research in high school physics and junior high school science subjects; (2) The selected articles are articles that contain research variables that are relevant to the research focus to be carried out. (3) The selected articles are articles published in the range of 2012-2021. (4) The selected articles are journal publications that already have an International Standard Serial Number (ISSN) as the identity of the publication, both in print and electronically. (5) The selected articles are articles published in reputable national journals and reputable international journals. Of the 33 articles, there are 20 articles indexed nationally and 13 articles indexed nationally and internationally; (6) The selected articles contain statistical data information that can be used to determine the effect size calculation.

Research variables are everything that has a certain variation that is determined by the researcher to be studied and then conclusions are drawn [44]. In this study there are 3 main variables, namely: (1) The cooperative learning model is the independent variable in this study; (2) The reliant variable in this study is understudy learning results;

(3) The level of the educational unit, the topic unit, the type of cooperative learning, and the research domain are the moderator variables in this study.

The procedure in this meta-analysis study was adapted to the meta-analysis steps as follows: the following: setting the research theme; determine relevant research; do the coding of article; calculate effect size; calculate the summary effect size; make interpretations, conclusions of analysis results and reporting [42]. The *summary effect size* for each article are interpreted into several categories those contained in table 1 are then analyzed according to the research objectives and conclusions are drawn. After that make a report on research results in accordance with the format of scientific reports as research results scientific.

**Table 1.** Interpretation of Effect Size Values (Effect Size)

No	Value Effect Size	Criteria
1	$ES \leq 0,15$	negligible effect
2	$0,15 < ES \leq 0,40$	small effect
3	$0,40 < ES \leq 0,75$	medium effect
4	$0,75 < ES \leq 1,10$	large effect
5	$1,10 < ES \leq 1,45$	very large effect
5	$ES > 1,45$	huge effect

(Source: Ref [45])

Although the Es is calculated in one paper, Hedges' *g* Es of it is re-calculated for consistent with other papers, and change between 0.02 and 0.10 is detected because technical differences. However, this change is not noticed due to its being too small and affecting the nature of the study. The used calculation formulas are seen in Table 2

Table 2. Using Formulas for Calculating effect Size

1. <i>Pre-PostContrassis</i>	$ES = \frac{\bar{x}_{post} - \bar{x}_{pre}}{SD_{pre}}$	Description: $ES$ = Effect Size $\bar{X}_{post}$ =Average posttest $\bar{X}_{pre}$ =Average posttest $SD$ =Standard deviation
2. <i>Group contrassis</i>	$ES = \frac{\bar{x}_E - \bar{x}_C}{SD_C}$	Description: $ES$ = Effect size $\bar{X}_E$ =Average of the experimental group $\bar{X}_C$ =Average of the control group $SD_C$ =Standard deviation of the control group
3. Determining <i>Summary Effect Size</i>	$M = \frac{\sum_{i=1}^k W_i \cdot Y_i}{\sum_{i=1}^k W_i}$	
4. Zero Hypothesis Test	$Z = \frac{M}{SE_M}$	If $p < \alpha$ , it means reject $H_0$ If $p > \alpha$ , it means accept $H_0$

### III. RESULTS AND DISCUSSION

#### A. *Research Results*

According to the classification of cooperative learning models' effects on under study learning results in high school physics and junior high school science subjects by calculating the measure from each article's effect size by recognizing 33 articles and the *Summary Effect Size*. *Summary effect sizes* are grouped based on moderator variables, namely the level of the education unit, the material unit, the type of cooperative learning and the research area.

#### 1. **The Impact of Cooperative Learning Model on Physics Learning Results of High School and Science Students Based on Subject Matter Units.**

The results of the analysis of the effect of the cooperative learning model on student learning results in high school physics and junior high school science subjects based on the education unit level with 33 articles analyzed can be seen in table 2.

**Table 2.** The Impact of Cooperative Learning Model on Physics Learning Results of High School and Science Students Based on Subject Matter Units

No	Education Unit Level	Number of Articles	Summary Effect Size Value	Category	Zero Hypothesis		Category
					Z	Probability	
1	SMA	21	1,084	Large effect	14,156	0,000	Ho rejected
2	SMP	12	0,806	Large effect	9,987	0,000	Ho rejected

According to Table 2 above, it can be seen that of the 33 articles analyzed about the impact of cooperative learning models on understudy learning results in physics subjects where more research was conducted at the high school education unit level as many as 21 articles compared to the junior high school level as many as 12 articles. This implies that the utilization of cooperative learning models in physics learning is utilized more frequently in high school instruction units than in junior high schools. The cooperative learning model applied in high school has an influence on physics learning results.

As can be seen in table 2 above, the *summary effect size* of cooperative learning models on understudy learning results with moderator variables for physics topics at the educational unit level. The high school education unit level's *summary effect size* value is 1.084, placing it in the large effect category. [45]. This means that the practical significance of the research results in the form of a measure of the magnitude of the effect of the cooperative learning model on understudy learning results in physics subjects is very strong at the large school education unit level.

The results of hypothesis testing show that the probability value for senior high school is less than 0.05 so  $H_0$  is rejected. This indicates that cooperative learning significantly affects the outcomes of physics learning for high school and junior high school science students.

## 2. The Impact of Cooperative Learning Model on Physics Learning Results of High School and Science Students Based on Subject Matter Units.

Using the analysis findings of the analysis of 33 articles that examine the impact of cooperative learning models on under study learning results in high school physics and junior high school science subjects based on material units, it can be seen in table 3.

**Table 3.** The Impact of Cooperative Learning Model on Physics Learning Results of High School and Science Students Based on Subject Matter Units.

No	Unit of Subject Matter	Number of Articles	Summary Effect Size Value	Category	Zero Hypothesis		Category
					Z	Probability	
1	Mechanics	23	0,982	Large effect	15,925	0,000	Ho rejected
2	Magnetism	3	1,590	Huge effect	3,747	0,000	Ho rejected
3	Thermodynamics	3	0,629	Medium effect	2,617	0,009	Ho rejected
4	Optical waves	4	0,803	Large effect	4,952	0,000	Ho rejected

Table 3 above shows that the impact of the cooperative learning model on under study learning results in physics subjects was mostly applied to the unit subject matter of mechanics with 23 articles, then the unit of subject matter to mechanical waves with 4 articles. This means that the cooperative learning model is more dominantly utilized for the unit of mechanics subject matter, compared to other material units.

From the conclusion of the *summary effect size* of the cooperative learning model on under study learning results in physics subjects with the moderator variable of the subject matter unit is displayed in table 3 above. The results show that the *summary effect size* value is 1,590 which is in the huge effect category, namely the unit of magnetic electricity subject matter [45]. This means that the influence of the are cooperative towards student learning outcomes in physics subjects with magnetic electricity units being more significant.

According to the findings of hypothesis testing, the probability value of the subject matter of mechanics, magnetism, thermodynamics and optical waves is smaller than 0.05 so that  $H_0$  is rejected. This means that cooperative learning has a significant impact on the learning results of mechanics, magnetism, thermodynamics and optical waves.

### 3. The Impact of Cooperative Learning Model on Physics Learning Results of High School and Junior High School Science Students Based on Cooperative Learning Type.

There are various types of cooperative learning models. Each kind of cooperative model has a unique impact on the understudy learning results in physics subjects. The types of cooperative learning models that are often applied in high school physics and junior high school science subjects can be seen in table 4 below.

**Table 4.** The Effect of Cooperative Learning Model on Student Learning Outcomes in terms of Cooperative Learning Types.

No	Cooperative Learning Type	Number of Articles	Summary Effect Size Value	Category	Zero Hypothesis		Category
					Z	Probability	
1	<i>Jigsaw</i>	7	0,648	Medium effect	6,779	0,000	Ho rejected
2	<i>Student Team Achievement Division</i>	8	0,978	Large effect	10,113	0,000	Ho rejected
3	<i>Number Head Together</i>	6	1,227	Very large effect	9,868	0,000	Ho rejected
4	<i>Team Games Tournaments</i>	6	1,516	Huge effect	5,051	0,000	Ho rejected
5	<i>Learning Cycle</i>	6	1,160	Very large effect	6,540	0,000	Ho rejected

From Table 4 it is shown that the type of cooperative learning that is often used in physics subjects is the *Student Team Achievement Division* as many as 8 articles. Then the *Jigsaw* model is 7 articles. This means that the cooperative learning type that is widely applied to physics subjects is the *Student Team Achievement Division* and *jigsaw models*.

Based on the results of the calculation of the *summary effect size* of the effect of the cooperative learning model on understudy learning results in physics subjects contained in table 4 above, value was obtained *summary effect size* on the moderator variable of the cooperative learning type, namely 1,516 which was in the huge effect category using the *Team Games Tournaments* [45]. The calculations finding the *summary effect size* means that the type of cooperative learning *Team Games Tournaments* has a more significant influence on understudy learning results in physics subjects compared to other types of learning.

The calculation of the hypothesis test's findings demonstrates that the *jigsaw* cooperative model, *Student Team Achievement Division*, *Number Head Together*, *Team Games Tournaments* and *learning cycle* have a probability value less than 0.05, meaning  $H_0$  is rejected. Therefore, it may be said that the *jigsaw type learning model*, *Student Team Achievement Division*, *Number Head Together*, *Team Games Tournaments* and *learning cycle* have a significant effect on physics learning results of high school and junior high school science students.

### 4. The Impact of Cooperative Learning Model on Student Learning Results in High School Physics and Junior High School Science Students Based on the Research Area.

The cooperative learning model has been applied in various research areas in high school physics and junior high school science subjects. The use of the cooperative model that has been carried out in various research areas has a significant influence on the learning results of physics in high school and science in junior high school. Table 5 displays the research area.

**Table 5.** The Impact of Cooperative Learning Model on Student Learning Outcomes by Research Area

No	Research Area	Number of Articles	Summary Effect Size Value	Category	Zero Hypothesis		Category
					Z	Probability	
1	North Sumatera	17	0,768	Large effect	8,205	0,000	Ho rejected

No	Research Area	Number of Articles	Summary Effect Size Value	Category	Zero Hypothesis		Category
					Z	Probability	
2	Jambi	2	1,006	Large effect	1,932	0,053	Ho accepted
3	South Sumatera	2	1,315	Very large effect	6,611	0,000	Ho rejected
4	Lampung	1	0,980	Large effect	3,892	0,000	Ho rejected
5	West Kalimantan	2	1,367	Lery large effect	7,704	0,000	Ho rejected
6	South Kalimantan	1	1,380	Very large effect	4,125	0,000	Ho rejected
7	Middle Sulawesi	2	0,962	Large effect	5,077	0,000	Ho rejected
8	South Sulawesi	2	0,822	Large effect	5,100	0,000	Ho rejected
9	West Nusa Tenggara	4	0,934	Large effect	7,125	0,000	Ho rejected

Based on table 5 shows that various research areas have implemented cooperative learning models so that it affects the learning outcomes of physics. The most dominant research area is North Sumatra with 17 articles, then West Nusa Tenggara with 4 articles. This means that the cooperative learning model is mostly studied in the research area of North Sumatra.

In accordance with the results of the *summary effect size* from the impact of the cooperative learning model on understudy learning results in physics subjects contained in table 5. *summary effect size* was obtained in the moderator of the research area, namely 1.380 which was in the very large effect category found in the study area. South Kalimantan [45]. The result of calculating the *summary effect size* means that the use of the cooperative learning model in the South Kalimantan region has a high significant impact on understudy learning results in physics subjects compared to other research areas.

According to the findings of hypothesis testing, the probability value of the research areas of North Sumatra, South Sumatera, Lampung, West Sumatera, South Kalimantan, Central Sulawesi, South Sulawesi, West Nusa Tenggara is less than 0.05, meaning Ho is rejected. This means that the cooperative learning model seen from the research area of North Sumatra, South Sumatera, Lampung, West Kalimantan, South Kalimantan, Central Sulawesi, South Sulawesi, West Nusa Tenggara has a significant influence on the physics learning results of high school and junior high school science students. While the Jambi region has a probability of 0.053 which is greater than 0.05 so that Ho is accepted. This means that the cooperative learning model seen from the Jambi research area has no significant impact on the physics learning results of high school and junior high school science students.

## B. Discussion

Calculations have been made in light of the study finding, it is known that a measure of the *summary effect size* of the impact of cooperative learning models on understudy learning results has varying values. This value is obtained from articles that have been analyzed and meet the article criteria.

The results of the first study on the impact of cooperative learning models on physics learning results are more dominant at the high school education unit level. Based on the *summary effect size*, the highest value is in the high school education unit, namely SMA Negeri 1 Kuala, Langkat Regency. This means that the impact of the learning model on physics learning results in high school is more effectively applied than in junior high school. The contribution size of the *effect size* at the junior high school level is large because the development of junior high school students aged around 11 years is a transitional period of cognitive development from the concrete operations stage. This transitional period is commonly referred to as the early cognitive stage where in general children's ability to think abstractly is still not fully developed, so that in terms of learning, it still requires media to visualize it [46]. Zero test results indicate that cooperative learning has a significant impact on physics learning results for high school and junior high school students

Learning at the high school level is more effective than the junior high school level. High school learning is more efficient since it is in agreement with the level of maturity (mainly in experience and age) [47]. Because of the maturity in experience and age that can be established through a constant learning process, it can be said that a student's education level determines how effective they are at learning. The choice of learning methods is influenced by a number of variables, including students. The selection of a learning method, must adjust the level of student education. The consideration that emphasizes the difference in education levels is on the ability of students, whether they are able to think abstractly or not. Simple and sophisticated methods are applied in very different ways, and both depend on the level of students cognitive and behavioral development. [48].

The results of the second study on the effect of cooperative learning models on physics learning outcomes are more dominant in the unit subject matter of mechanics. When viewed from the *summary effect size*, the highest value is in the subject matter unit, namely electric magnetism. This demonstrates that the cooperative learning paradigm significantly affects student learning outcomes in the magnetic electricity unit of study. The impact of implementing cooperative learning models on students learning results depending on unit subject matter is determined by the value of the *summary effect size*. The measure of magnetic and electrical substance is better than the unit of mechanics, thermodynamics and optical waves because it belongs to the very high category. In the electrical and magnetic material unit the sub-materials are interdependent, so that students can learn through group discussions so that each student can exchange ideas and can teach group friends who do not understand because cooperative learning depends on each other. For students, cooperative learning will make it simpler to locate and comprehend challenging concepts. [49]. The results of testing the null hypothesis indicate that cooperative learning has a significant effect on learning outcomes of mechanics, electricity, magnetism, thermodynamics and optical waves.

The teacher must be able to describe the lesson material into elements in detail in the lesson plan. Based on these elements, it appears whether the lesson material contains facts and skills that only require mental power to master it or contains skills and habits that require motor mastery, or only several things or maybe only one thing. After knowing the nature and elements of teaching materials, the teacher can apply a method that has characteristics that are in accordance with the teaching material in question, then determine one or several methods to be used in teaching [50].

The topic matter element is one of many variables that affect the choice of learning strategies. The provision of subject matter for students in learning activities has different depth, breadth, and complexity [48]. Due to the different characteristics of students, the way students receive the material being taught is also different. Therefore, the use of appropriate learning methods is needed in helping teachers convey the material well to students. The use of appropriate learning methods can provide a practical way for teachers to overcome the level of difficulty faced by students with learning materials.

The results of the third study on the impact of cooperative learning models on physics learning results are more dominant in the Student Team Achievement Division type. Based on the summary effect size value, the impact of the cooperative learning model on higher learning results is in the Team Games Tournaments type. Therefore, there is a big impact of the cooperative learning approach on student learning results in the Team Games Tournaments type. The impact to fusing cooperative learning models on students learning results depends on the type of cooperative learning, according to the *summary effect size* value. The kind of team games tournaments cooperative learning that has a very high category is the kind of cooperative learning that has the most impact. The outcomes of student learning are improved when the Team Games Tournaments cooperative learning paradigm is used. TGT type cooperative learning emphasizes cooperation, critical thinking and developing social attitudes so that it can increase creativity, achievement, cooperation and foster social attitudes among students [38]. The overall cooperative learning paradigm of the TGT type has a significant impact on how students learn physics. This demonstrates how highly successful and powerful TGT type cooperative learning is in enhancing student learning results. [51]. From the results of testing the null hypothesis, it shows that the *jigsaw* type learning model, *Student Team Achievement*, *Number Head Together*, *Team Games Tournaments* and *learning cycle* have a big impact on physics learning outcomes for high school and junior high school science students.

The research area in the province of North Sumatra is more predominantly affected by the cooperative learning model impact on learning results. When viewed from the *summary effect size*, the highest values in the province of South Kalimantan. This indicates that in the South Kalimantan province research area, the cooperative learning paradigm has a considerable impact on the learning results for physics. The impact of applying cooperative learning models on learning results based on the research area can be determined using the findings of the computation of the *summary effect size*. The province of South Kalimantan has the highest influence with a very high category. This demonstrates that using a cooperative learning paradigm based on the study topic can significantly enhance students learning results. According to the outcomes of testing the null hypothesis, the cooperative learning model seen from the research area of North Sumatera, South Sumatera, Lampung, West Kalimantan, South Kalimantan, Central Sulawesi, South Sulawesi, West Nusa Tenggara has a substantial impact on the physics learning results of high school and junior high school science students. While the cooperative

learning model seen from the Jambi research area has no discernible impact on the physics learning outcomes of high school students and junior high school science students.

#### IV. CONCLUSION

According to the study finding it can be said that the impact of cooperative learning model on learning results of physics and science based on the level of the education unit is effectively use at the high school level with a *summary effect size* of 1.084 categorized as large effect, based on the subject matter unit it is very influential on the magnetic electric material unit with a *summary effect size* of 1.516 categorized as huge effect, based on the type of effective cooperative learning used in the Team Games Tournaments type with a *summary effect size* of 1.516 categorized as huge effect and based on the research area it was influential in the South Kalimantan region with a *summary effect size* of 1.380 categorized as very large effect

#### REFERENSI

- [1] Sari. R. M, Analisis Kebijakan Merdeka Belajar Sebagai Strategi Peningkatan Mutu Pendidikan, *Produ: Prokurasi Edukasi Jurnal Manajemen Pendidikan Islam*, 1(1), 2019.
- [2] Sinambela, P. N, Kurikulum 2013 dan Implementasinya dalam Pembelajaran. Medan: Generasi Kampus, 2013.
- [3] Asrizal. A., Hendri. A., Hidayati. H., & Festiyed. F, Penerapan Model Pembelajaran Mengintegrasikan Laboratorium Virtual dan HOTS untuk Meningkatkan Hasil Pembelajaran Siswa SMA Kelas XI, *Jurnal Pds Unp*, 1(1), 49-57, 2018.
- [4] Harahap. F. M., & Siagian. H, Pengaruh Model Pembelajaran Kooperatif Tipe Numbered Head Together (NHT) Terhadap Hasil Belajar Siswa Pada Materi Usaha dan Energi, *Jurnal Inpafi*, 3(1), 55-61. 2018.
- [5] Putra. A. A., Hardianti. T., Syahwin. S., & Fauzi. F, Pengaruh Model Pembelajaran Jigsaw Terhadap Hasil Belajar Pada Materi Usaha dan Energi, *PASCAL (Journal of Physics and Science Learning)*, 2(1), 9-16, 2018.
- [6] Trianto, *Model Pembelajaran Terpadu*, Jakarta: PT Bumi Aksara, 2012.
- [7] Amin. A., Charli. L., & Fita. W. N, Pengaruh Model Pembelajaran Kooperatif Tipe Jigsaw dan Kemandirian Belajar Terhadap Hasil Belajar Fisika, *SPEJ (Science and Physics Education Journal)*, 2(1), 11-17, 2018.
- [8] Saenab. S., Mamin. R., & Arding. N. I, Pengaruh Model Pembelajaran Kooperatif Tipe Jigsaw Terhadap Hasil Belajar IPA Kelas VIII SMPN 1 Mattiro Bulu (Pada Materi Pokok Usaha dan Energi), *Jurnal IPA Terpadu*, 3(1), 20-30, 2019.
- [9] Lubis. A, Pengaruh Model Pembelajaran Kooperatif Tipe STAD Terhadap Hasil Belajar Fisika Siswa Pada Materi Pokok Gerak Lurus di Kelas X SMA Swasta UISU Medan, *Jurnal Pendidikan Fisika*, 1(1), 27-32, 2012.
- [10] Bahtiar, Musanni, & Hapipah. L, Pengaruh Model Pembelajaran Kooperatif Tipe NHT (Numbered Head Together) Menggunakan Peta Konsep Terhadap Hasil Belajar Fisika Siswa, *Jurnal Prisma Sains*, 1(1), 49-54, 2013.
- [11] Sinulingga. K, Pengaruh Model Pembelajaran Learning Cycle Berbasis Peta Konsep Terhadap Hasil Belajar Siswa Pada Materi Pokok Listrik Dinamis, *Jurnal Pendidikan Fisika*, 2(1), 2013.
- [12] Susanto. I, Waruwu. L, Siahaan. D. I., & Halawa. E, Pengaruh Model Learning Cycle Terhadap Hasil Belajar Fisika Pada Materi Pokok Suhu Dan Kalor Siswa Kelas X Mas Bina Ulama Kisaran Semester II T.P 2020/2021, *Jurnal Penelitian Fisikawan*, 4(2), 1-6, 2021.
- [13] Dianta. S., Tandililing. E., & Mursyid. S, Penerapan Model Pembelajaran Kooperatif Tipe Jigsaw untuk Meningkatkan Hasil Belajar Peserta Didik tentang Pengukuran, *Jurnal Pendidikan dan Pembelajaran Khatulistiwa*, 10(4), 2021.
- [14] Hutahean. J., & Ratna. S. D, Pengaruh Model Pembelajaran Kooperatif Tipe Numbered Head Together (NHT) dengan Menggunakan Media Mind Mapping Terhadap Hasil Belajar Siswa Kelas XI Semester 2 Pada Materi Pokok Fluida Statis di SMA Negeri 10 Medan Tp. 2013/2014, *Jurnal INPAFI*, 2(4), 2014.
- [15] Turnip. B. M., & Turnip. I. F, Pengaruh Model Pembelajaran Kooperatif Tipe Tgt Disertai Joyfull Learning Terhadap Hasil Belajar Fisika Siswa SMA, *Jurnal INPAFI*, 2(2), 2014
- [16] Sakdiah. H, Pengaruh Model Pembelajaran Learning Cycle Terhadap Hasil Belajar Fisika Siswa SMA, *Relativitas*, 1(1), 2018
- [17] Rafiqah, Amin. F., & Wayong. M, Pengaruh Learning Cycle Berbasis Metode Konflik Kognitif untuk Meningkatkan Pemahaman Konsep Fisika, *Jurnal Pendidikan Fisika*, 7(2), 2019.
- [18] Nuraeni. N, Strategi Pembelajaran untuk Anak Usia Dini. Mataram: *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP*, 2(2), 143-153, 2014.



- [19] Millah, D, Audience Centered Pada Metode Presentasi Sebagai Aktualisasi Pendekatan Student Centered Learning. *Edukasia: Jurnal Penelitian Pendidikan Islam*, 10(2), 2015.
- [20] Laratu, I. N. N., Syamsu, & Kamaluddin, Penerapan Model Pembelajaran Kooperatif Tipe STAD Berbasis Unjuk Kerja untuk Mengukur Hasil Belajar Fisika Pada Siswa Kelas VIII SMP Negeri 13 Palu, *Jurnal Pendidikan Fisika Tadulako (JPFT)*, 4(2), 2016.
- [21] Asma, N, *Model Pembelajaran Kooperatif*, Padang: UNP Press, 2009.
- [22] Annisa, Rhoudatul. Meta-Analisis Pengaruh Model Pembelajaran Kooperatif Terhadap Hasil Belajar Fisika Peserta Didik. *Jurnal Pds Unp*, 1(1), 222-246, 2018.
- [23] Urwati, K., Ernita, N., & Yahdi, Y. Pengaruh Model Pembelajaran Kooperatif Tipe Jigsaw terhadap Hasil Belajar Kognitif Siswa pada Materi Hukum Newton Kelas X di MA Darul Muhajirin Praya. *Journal of Natural Science and Integration*, 2(2), 203-215. 2019.
- [24] Susanto, I. (2020). Pengaruh Model Pembelajaran Kooperatif Tipe Jigsaw Terhadap Hasil Belajar Fisika Siswa Kelas X Semester I SMA Swasta Gajah Mada Padang Bulan Medan. *Jurnal Penelitian Fisikawan*, 3(1), 1-7.
- [25] Kasih, B. S., Nyeneng, I. D. P., & Distrik, I. W. Efektivitas Model Pembelajaran Jigsaw Dalam Pembelajaran IPA Fisika Pada Siswa SMP Negeri 28 Bandar Lampung. *Jurnal Pendidikan Fisika*, 7(2), 189-202. 2019
- [26] Syahprianti, E., Fauzi, M., Matondang, A., & Mardiana, N. Perbandingan Model Student Teams Achievement Divisions Dengan Direct Instruction Menggunakan Handout Terhadap Hasil Belajar Siswa Kelas X Pada Materi Besaran dan Satuan. *Pascal (Journal of Physics and Science Learning)*, 2(1), 44-58. 2018.
- [27] Saputra, L.M. R. S. Pengaruh Pembelajaran Kooperatif Tipe STAD Terhadap Hasil Belajar Fisika Siswa Kelas X SMA Muhammadiyah Masbagik Tahun Pelajaran 2012/2013. *Lens: Journal of Physics Education*, 1(1), 8-16. 2013.
- [28] Gumay, O. P. U., Kodarsih, E., & Mulyanto, A. B. Pengaruh Model Pembelajaran Kooperatif Tipe Student Teams Achievement Division (STAD) Terhadap Hasil Belajar Fisika Siswa Kelas X SMA Negeri 2 Muara Beliti Tahun Pelajaran 2015/2016. In *Prosiding Seminar Nasional Fisika (E-Journal) (Vol. 5, pp. SNF2016-EER)*. 2016.
- [29] Manik, I. S., & Bukit, N. Pengaruh Model Pembelajaran Kooperatif Tipe Student Team Achievement Division (STAD) terhadap Hasil Belajar Siswa pada Materi Usaha dan Energi di SMP Muhammadiyah 1 Medan. *INPAFI (Inovasi Pembelajaran Fisika)*, 2(2), 2014.
- [30] Hasanah, H., Suyidno, S., & Wati, M. Pengaruh Pembelajaran Kooperatif Tipe Student Team Achievement Division (STAD) Dengan Latihan Berstruktur Terhadap Hasil Belajar Siswa. *Berkala Ilmiah Pendidikan Fisika*, 2(1), 47-54, 2014.
- [31] Suwaningsih, N., Pasaribu, M., & Darsikin, D, Pengaruh Pembelajaran Kooperatif tipe STAD Berbasis Mind Mapping terhadap Hasil Belajar Fisika pada Pokok Bahasan Cahaya di SMP Negeri 18 Palu. *JPFT (Jurnal Pendidikan Fisika Tadulako Online)*, 5(2), 19-24, 2017
- [32] Susanti, F., Ayub, S., & Taufik, M, Perbedaan Hasil Belajar Fisika Melalui Model Pembelajaran Kooperatif Tipe Numbered Heads Together (NHT) Berbantuan Kartu Soal Dengan Model Pembelajaran Direct Instruction di SMAN 7 Mataram Tahun Ajaran 2015/2016. *Jurnal Pendidikan Fisika dan Teknologi*, 2(4), 147-153, 2016.
- [33] Trisianawati, E., Djudin, T., & Stianingsih, Y. D, Pengaruh Penerapan Model Pembelajaran Numbered Head Together (NHT) Terhadap Hasil Belajar Siswa. *Jurnal Berkala Ilmiah Pendidikan Biologi*, 6(3), 2018.
- [34] Siregar, F. A, Pengaruh Model Kooperatif Tipe NHT Terhadap Hasil Belajar Siswa Kelas VIII SMP Negeri 18 Medan. *Jurnal Pendidikan Fisika*, 1(1), 33-38, 2012
- [35] Simamora, P., & Nadia, N, Pengaruh Model Pembelajaran Kooperatif Tipe Teams Games Tournaments (TGT) Terhadap Hasil Belajar Siswa Pada Materi Usaha dan Energi. *INPAFI (Inovasi Pembelajaran Fisika)*, 5(2), 2017.
- [36] Perangin-angin, J. P., & Simamora, P, Pengaruh Model Pembelajaran Kooperatif Tipe Teams Games Tournament (TGT) Terhadap Hasil Belajar Siswa Pada Materi Pokok Usaha dan Energi. *INPAFI (Inovasi Pembelajaran Fisika)*, 5(3), 2017.
- [37] Purwanto, P., & Annisa, J, Pengaruh Model Pembelajaran Kooperatif Tipe Teams Games Tournament (TGT) Menggunakan Media Permainan Monopoli Terhadap Hasil Belajar Fisika Siswa pada Materi Fluida Statis. *Jurnal Ikatan Alumni Fisika Universitas Negeri Medan*, 2(2), 34-39, 2019.
- [38] Sakdiah, H., & Sasmita, P. R, Pengaruh Model Pembelajaran TGT Berbantuan Media Simulasi Phet dalam Meningkatkan Hasil Belajar. *JPF (Jurnal Pendidikan Fisika)*, 6(2), 65-70, 2018.
- [39] Ulfia, T., & Irwandani, I, Model Pembelajaran Kooperatif Tipe Teams Games Tournament (TGT): Pengaruhnya Terhadap Pemahaman Konsep. *Indonesian Journal of Science and Mathematics Education*, 2(1), 140-149, 2019.

- [40] Maida, T., & Sirait, M, Pengaruh Model Pembelajaran Learning Cycle terhadap Hasil Belajar Siswa pada Materi Pokok Fluida Statis di Kelas XI Semester II SMA Dharma Pancasila Medan TP 2016/2017. *INPAFI (Inovasi Pembelajaran Fisika)*, 5(4), 2017.
- [41] Anisah, A., & Purwanto, Pengaruh Model Pembelajaran Learning Cycle terhadap Hasil Belajar Fisika. *INPAFI (Inovasi Pembelajaran Fisika)*, 2(1), 2014.
- [42] Retnawati, H. dan EziApino, *Pengantar Analisis Meta*, Yogyakarta: Parama Publishing, 2018.
- [43] Dewi, N. K. N. S., Astawan, I. G., & Margunayasa, I. G, Analisis Pengaruh Model Pembelajaran Kolaboratif Terhadap Hasil Belajar IPA Siswa Sekolah Dasar, *MIMBAR PGSD Undiksha*, 8(2), pp 294-302, 2020.
- [44] Sugiyono, *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*, Bandung: Alfabeta, 2012
- [45] Dinçer, S. Türkiye’de yapılan bilgisayar destekli öğretimin öğrenci başarısına etkisi ve diğer ülkelerle karşılaştırılması: Bir meta-analiz çalışması. *Journal of Turkish Science Education*, 12(1), 99-118, 2015
- [46] Suprijono, A. *Cooperative learning teori dan aplikasi PAIKEM*. Yogyakarta: Pustaka Pelajar, 2017.
- [47] Syafrial, S., Meta-Analisis Cooperative Learning Terhadap Kemampuan Berpikir Kritis Pada Pembelajaran Ipa/Fisika Siswa, *Journal of Teaching and Learning Physics*, 3(1), pp 27-33, 2018.
- [48] Darmadi, *Pengembangan Model dan Metode Pembelajaran dalam Dinamika Belajar Siswa*, Yogyakarta: Deepublish, 2017.
- [49] Mardiyah, S., Peningkatan Hasil Belajar IPA Melalui Model Pembelajaran Kooperatif Tipe Think Pair and Share Pada Peserta Didik Kelas VII SMP Negeri 5 Makassar, *Jurnal Pendidikan Fisika*, 5(1), pp 25-36, 2017.
- [50] Hamdayama, Jumanta, *Metodelogi Pengajaran*, Jakarta: Bumi Aksara, 2016.
- [51] Aziz, N. R. N., Dasmo, D., & Setiadi, A., Studi Meta-Analisis Model Pembelajaran Kooperatif tipe Teams Games Tournament (TGT) dalam Pembelajaran Fisika. *Schrodinger Jurnal Ilmiah Mahasiswa Pendidikan Fisika*, 2(2), pp 108-115, 2021.