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# Effects of Cooperative Learning Model in Science Learning on Students' Cognitive and Critical Thinking Ability: A Meta Analysis

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**ABSTRACT** (10 PT)

*Learning requires students to be able to improve the various abilities needed in the 21st century. However, student abilities were still low. The solution to the problem is to apply a cooperative learning model. This study aims to determine the effect of using the cooperative model on students' knowledge abilities and critical thinking skills in science learning which is determined through the effect size. This study uses a descriptive meta-analysis research method. Research data were obtained from 20 journals about the effect of using the cooperative learning model, where there were 10 journals related to learning outcomes and 10 journals on students' critical thinking skills. Research is based on two categories, the ability achieved and the type of cooperative learning model. The results showed that the use of the cooperative model in the category of student ability obtained an average effect size of 0.93 high category on learning outcomes and an average effect size of 1.08 high category on critical thinking skills which showed a positive influence in improving student abilities. Second, based on the type of cooperative learning model, the average effect size is 0.74 in the medium category, which indicates that the use of cooperative learning models is still less effective in improving student learning outcomes. The average effect size value for critical thinking skills which shows the type of cooperative learning model is 0.76 has a positive effect on students' critical thinking skills. Therefore, it is important for educators to use learning models to improve students' skills.*



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## INTRODUCTION

Education is a learning process that can be carried out deliberately by every human being. This statement is in accordance with Law no. 20 of 2003 concerning the National

Education System states that: "Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential". Students must have religious spiritual strength, self-control, personality, intelligence, noble character, and the skills needed by themselves, society, nation and state (Sanjaya, 2001). Education can also be interpreted as a process with certain methods so that people gain knowledge. However, knowledge alone is not enough to realize the Era of the Industrial Revolution 4.0, because there needs to be a balance between knowledge and skills as the basis for quality human resources in the changing times (Mardhiyah et al., 2021).

Learning in the 21st century is expected to open up wider employment opportunities and expand employment opportunities for Indonesian people as quality and superior human resources. Quality human resources can be formed through 21st century learning which of course must be relevant to the development of the Industrial Revolution Era 4.0. 21st century learning focuses on student centers with the aim of giving students thinking skills including: (1) critical thinking, (2) problem solving, (3) metacognition, (4) communicating, (5) collaborating, (6) innovation and creative, (7) information literacy (Mardhiyah., 2021). Therefore, it is hoped that education can create quality human resources in the field of information technology and also human aspects because 21st century learning integrates more knowledge and skills. However, the current implementation of education still has drawbacks, namely the problems that arise. Some of them are the low student learning outcomes in science subjects, and the weak learning process that is carried out makes students less encouraged to develop thinking skills.

The low student learning outcomes, especially in science subjects, is caused by the low absorption and initial abilities of students when participating in lessons and the learning models used by teachers are less varied, thus making students less interested in learning science and teacher-centered learning. Based on the results of research conducted by Wida Mustika (2019) shows that the use of learning models in science learning can improve learning outcomes and students' critical thinking skills. This is in line with research conducted by Saparuddin et al., (2021) states that there is a significant positive relationship between critical thinking skills and student learning outcomes. Even so, the teacher prefers to apply the conventional model because it does not require practical tools and materials, it is enough to explain the concepts in textbooks or other references. This problem is often encountered in the learning process activities in the classroom, so it is necessary to apply learning strategies or models that can help students to understand teaching materials and their applications as well as their relevance in everyday life.

The ability to think critically is one of the basic capital that is very important for everyone. A teacher must be able to create learning that is able to train students' critical thinking skills to find learning information independently and actively create cognitive structures in students (Patonah, 2014). Hasruddin revealed that instilling critical thinking skills for students needs to be done so that they can examine the various problems they face. Students will have a deep understanding if the learning process emphasizes critical thinking skills (Hasruddin, 2009). (Santika & Hartono, 2014) states that the ability to think critically is one of the most important intellectual capital for everyone, to lead to human maturity. The ability to think critically will make them resilient in dealing with various problems, able to solve them appropriately, and able to apply the knowledge material obtained at school to various different situations in real everyday life.

Critical thinking skills are students' ability to adapt to various situations and solve problems. Critical thinking skills are paying attention to the epistemological development of students' thinking, finding problems, playing an active role, and interacting with students (Virijai et al., 2022). Students' critical thinking skills getting better actually do not come by themselves, there must be systematic efforts to achieve them. The use of a more interesting

and varied learning model set by the teacher in the classroom is one solution, in this case the researcher will use a cooperative learning model.

Cooperative learning is a learning model through small groups of students who work together in maximizing learning conditions to achieve learning goals. Students in cooperative learning work in small groups collaboratively whose members range from 2 to 5 people with a heterogeneous group structure. This cooperative learning makes learning situations interesting because in the learning process, students will interact with each other. The cooperative learning model has advantages, where Jhonsoon and Jhoonson in their research put forward several advantages of the cooperative learning model. The purpose of this study was to determine whether or not there was an effect of using cooperative learning models on students' learning outcomes and critical thinking skills.

## METHODS

The method used in this research is meta-analysis method. Meta-analysis is research conducted by summarizing, reviewing and analyzing data from several studies that have been conducted. In meta-analysis research, it is statistical analysis in the form of quantitative data derived from a large collection of analysis results in an individual study with the aim of integrating them into a conclusion. Data from meta-analysis is quantitative because meta-analysis uses calculations in the form of numbers and requires a lot of data which is not possible with other methods (Pramita et al., 2021). This study uses a meta-analytic research method by reviewing several articles in national and international journals. Data were obtained from journals relevant to research, namely journals regarding the use of cooperative models on learning outcomes and students' critical thinking skills in science learning. After searching, there were 20 journals that were found in accordance with this research as well as data information in them that could be processed.

To determine the magnitude of the effect size can be determined, in statistical parameters as presented in table 1. After obtaining the Effect Size (ES), the results can be interpreted according to predetermined criteria if ES (0 < ES < 0.2), then it is in the low category. If ES (0.2 < ES < 0.8), it is categorized as moderate. If (ES > 0.8) then it is categorized as high. This can be seen and explained based on Table 1 and Table 2 below:

**Table 1.** How to Determine the Magnitude of the Effect Size

| No. | Statistics | Equation | Formula |
|---|---|---|---|
| 1. | Average in one group | $ES = \frac{\bar{X}_{post} - \bar{X}_{pre}}{SD_{pre}}$ | Fr-1 |
| 2. | Average in each group (*two groups posttest only)* | $ES = \frac{\bar{X}_E - \bar{X}_C}{SD_C}$ | Fr-2 |
| 3. | Average in each group (*two groups pre-post tests*) | $ES = \frac{(\bar{X}_{post} - \bar{X}_{pre})_E - (\bar{X}_{post} -}{\frac{SD_{preC} + SD_{preE} + SD_{po}}{3}}$ | Fr-3 |
| 4. | Chi-Square | $ES = \frac{2r}{\sqrt{1-r^2}}; \sqrt{\frac{\chi^2}{n}}$ | Fr-4 |
| 5. | t-test | $ES = t\sqrt{\frac{1}{n_E} + \frac{1}{n_C}}$ | Fr-5 |
| 6. | P value | CMA (*Comperhensive Meta Analisis Software)* | Fr-6 |

**Tabel 2.** Effect Size Category

| *Effect Size* | Category |
|---|---|
| ES ≤ 0,15 | Very Low |
| 0,15< ES ≤ 0,40 | Low |
| 0,40< ES ≤ 0,75 | Medium |
| 0,75< ES ≤ 1,10 | High |
| ES >1,10 | Very High |

(Source: Asti, 2018)

## RESULTS AND DISCUSSION

### Results

***The Effect of Cooperative Learning Model on Learning Outcomes and Students' Critical Thinking Ability***

From the journal analysis that has been carried out regarding the use of cooperative learning models on learning outcomes and students' critical thinking abilities. There were 20 journals analyzed at the junior and senior high school levels. Where there are 10 journals related to student learning outcomes. As well as 10 journals on the use of cooperative models on students' critical thinking skills. The average value of the effect size on student learning outcomes and critical thinking skills can be seen in Table 3.

**Tabel 3**. Analysis of the Use of Cooperative Learning Models on Learning Outcomes and Students' Critical Thinking Skills

| Code | Competence | ES | Average ES | Category | Authors |
|---|---|---|---|---|---|
| H1 | Cognitive Learning Outcomes | 0.48 | 0.93 | High | (Siburian et al., 2020) |
| H2 | | 0.72 | | | (Wahyuni & Rizal, 2022) |
| H3 | | 0.99 | | | (Lagur et al., 2018) |
| H4 | | 1.15 | | | (Hatibe & Darmadi, 2021) |
| H5 | | 1.78 | | | (Damanik et al., 2020) |
| H6 | | 0.43 | | | (Riska, Syamsu, 2020) |
| H7 | | 1.40 | | | (Susy Pramanita Manurung dan Makmur Sirait, 2021) |
| H8 | | 1.25 | | | (Siagian, Ira Santi, 2022) |
| H9 | | 0.58 | | | (Maiyena et al., 2021) |
| H10 | | 0.51 | | | (Hulu, 2020) |
| K1 | Critical Thinking | 1.30 | 1.08 | High | (Peranginangin, 2021) |

| | | | | | |
|---|---|---|---|---|---|
| K2 | | 2.12 | | | (Latifah, 2015) |
| K3 | | 0.72 | | | (Febriana & Mustari, 2018) |
| K4 | | 0.87 | | | (Lapasere et al., 2017) |
| K5 | | 1.60 | | | (Wati & Anggraini, 2019) |
| K6 | | 1.13 | | | (Darsana et al., 2019) |
| K7 | | 0.63 | | | (Herawati & Irwandi, 2019) |
| K8 | | 0.57 | | | (Suparyana, 2018) |
| K9 | | 1.50 | | | (Muliana et al., 2019) |
| K10 | | 0.42 | | | (Damayanti et al., 2019) |

From table 3 it can be seen the effect size of the use of cooperative learning models on student learning outcomes and critical thinking skills. On student learning outcomes consisting of 10 journal articles, an average effect size of 0.93 is found in the high category. This suggests that the cooperative model can improve student learning outcomes at the junior and senior high school levels in science subjects. Regarding students' critical thinking skills, there were 10 journal articles, an average effect size of 1.08 in the high category. This suggests that the cooperative model can improve students' critical thinking skills at the junior and senior high school levels in science learning. So from table 3 it can be concluded that the cooperative learning model has a significant influence on student learning outcomes and critical thinking skills.

***Effects of Cooperative Learning Models on Student Learning Outcomes Based on Types of Cooperative Learning Models***

Journal analysis conducted on 10 journals on the use of cooperative learning models to improve learning outcomes and students' critical thinking skills at the junior and senior high school levels found 5 journals based on the type of cooperative learning model that can improve student learning outcomes. The results of the analysis can be seen in Figure 1.

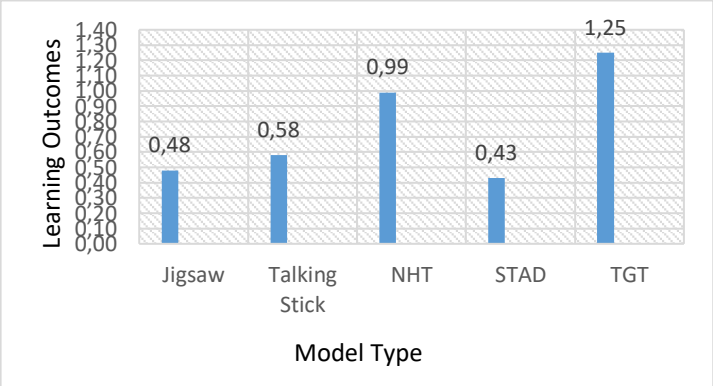


**Figure 1.** The Effect of Cooperative Learning Model on Student Learning Outcomes Based on Model Type

Based on Figure 1, it can be seen that the value of the effect size in the use of cooperative models to improve student learning outcomes in science learning. From Figure 1 it can be seen that the value of the effect size in each type of cooperative learning model is different. Where there are five types of cooperative learning models namely jigsaw, talking stick, NHT, STAD, and TGT. The TGT (Teams Games Tournaments) type has a very high effect size value of 1.25 and the STAD type has an effect size of 0.43 in the medium category. The average effect size value for the cooperative model type to improve junior high school student learning outcomes in science learning is 0.74 in the medium category. This suggests that the use of cooperative learning models with certain types is still not used effectively to improve student learning outcomes in science learning at the junior high/high school education level.

***The Effect of Cooperative Learning Model on Students' Critical Thinking Ability Based on the Type of Cooperative Learning Model***

Journal analysis conducted on 10 journals about the use of cooperative learning models. The data obtained comes from 5 journals that use certain types to improve students' critical thinking skills. Analysis of the use of certain types of cooperative learning models to improve students' critical thinking skills in science learning can be seen in Figure 2.

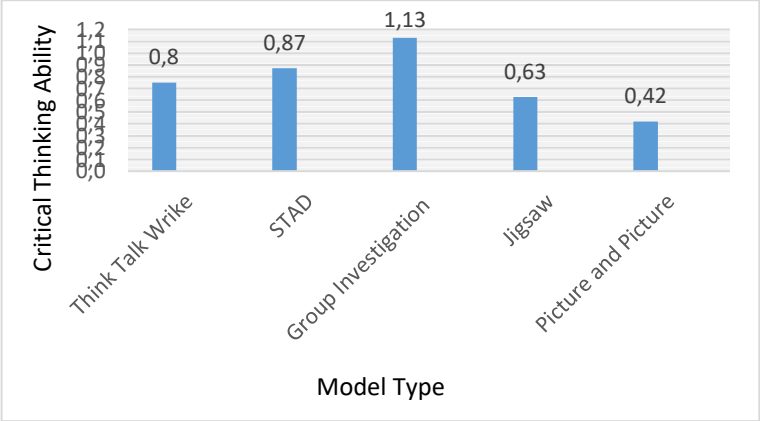


**Figure 2.** The Use of Cooperative Learning Models on Students' Critical Thinking Ability Based on Model Types

Based on Figure 2, it can be seen that the value of the effect size in the use of certain types of cooperative learning models to improve students' critical thinking skills. From Figure 2 it can be seen that the value of the effect size in each type of cooperative learning model is different. Where there are 5 types of cooperative learning models used, namely Think Talk Wrike, STAD, Group Investigation, Jigsaw, and Picture and Picture. The Group Investigation learning model type has a very high effect size value of 1.13. Whereas in the Picture and Picture learning model type, the effect size value is 0.42 with the low category. The average effect size value for the type of cooperative learning model used is categorized as high, namely 0.76. This suggests that the type of cooperative learning model used or developed has an effect on students' critical thinking skills in science learning, for the junior high/high school education level.

**Discussion**

Based on the results of the analysis of 20 articles that have been carried out by researchers, it shows that the cooperative learning model can improve learning outcomes and students' critical thinking skills in science learning. Critical thinking is important and fundamental to all sciences. Critical thinking is the ability to make judgments about one or

more statements and make objective decisions based on considerations and supporting facts (Saparuddin et al., 2021). The indicators of critical thinking skills above are closely related to cognitive learning outcomes which involve students' abilities to remember, understand, apply, analyze, synthesize and evaluate so that cognitive abilities and critical thinking are interconnected, especially in the learning process using the right model.

The results of this study are supported by research conducted by (Wida Mustika, 2019), states that there is a positive relationship between cognitive abilities and students' critical thinking skills in describing a material into explanations that are easier for students to understand and understand. The same is expressed by (Ermin & Marsaoly, 2021) which states that the cooperative model can improve students' critical thinking skills. In this study, two research results were obtained. First, based on the analysis of 10 articles about the use of cooperative learning models on student learning outcomes, the average effect size value is 0.93, which is in the high category. This shows that the use of cooperative learning models can improve student learning outcomes in science learning. The results of this meta-analysis research are in line with research conducted (Maiyena et al., 2021) that cooperative learning has an effect on student learning outcomes, this is evidenced by the increase in the average score of student physics learning outcomes. Second, based on the results of the analysis of 10 articles about the use of cooperative learning models on students' critical thinking skills, the average effect size value was 1.08 in the high category. This shows that the use of cooperative learning models can improve students' critical thinking skills in science learning.

## CONCLUSION

Based on the data analyzed, the conclusions in this study are as follows. First, the use of cooperative learning models to improve student learning outcomes in the high category, this means that cooperative learning models have a significant effect on student learning outcomes in science learning, for junior high school education levels as well as high school. Second, the use of cooperative learning to improve students' critical thinking skills in the high category, this means that the cooperative learning model has a significant effect on improving students' critical thinking skills in science learning, for junior and senior high school education levels.

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