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Meta-Analysis of the Influence of Cooperative Learning Models on Aspects of Learners' Physical Knowledge

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Abstract

21st-century learning integrates knowledge, attitudes, and skills with mastery of technology. One solution for the learning demands of the 21st century is to apply a cooperative learning model, especially in physics subjects. Researchers used the methodization method in this study with 20 national article sources. The analysis results are reviewed based on the types of cooperative models, grade levels and physics materials contained in the article. Based on the average effect size, the influence of collaborative learning on aspects of students' physical knowledge was obtained in terms of the three groupings in the high category. It states that cooperative learning models have a very effective influence on physics lessons.

INTRODUCTION

21st-century learning integrates knowledge, skills, attitudes and mastery of technology. Students are required to have skills to compete and adapt to technological developments. The goal is to produce students with 4C skills (critical thinking, communication, collaboration and creativity) that align with the demands of the 21st century (US-based Partnership For 21st). 21st-century 4C skills can be realized if the learning process is held interactively, inspiring, fun, and challenging, motivating students to participate [1] actively.

The hope of 21st-century education is certainly in line with the national education objectives contained in Law Number 20 of 2003 concerning the national education system article 3. The purpose of national education includes developing the potential of students to become human beings who have faith and piety in God Almighty, have a noble character, are healthy, knowledgeable, capable, creative, independent and become democratic and responsible citizens. The learning process is held interactively, inspiring, fun, and challenging, motivating students to participate actively.

Can be achieved if students have four pillars of education by UNESCO: learning to know, learning to do, learning to be, and learning to live together. If these four pillars are applied in the automatic learning, learning will change phases from teacher centre to student centre so that it can develop student skills such as effective communication, problem-solving, independent learning and various other information [2]

21st-century learning is in line with the demands of the 2013 Curriculum. First, students must be active, creative and innovative in education. Both students are required to develop talents, interests and potential for character, competence and literacy. It can be realized through learning experiences from simple to complex. Teachers are required to have the ability to vary the teaching and learning process so that learning is not monotonous and does not saturate students [3].

In essence, 21st-century skills have been adapted to the Indonesian education system through the 2013 Curriculum. Scientific approaches and authentic assessment have been applied to learning the 2013 Curriculum [4]. The scientific method has five procedures, namely observing, questioning, exploring or collecting data, associating and communicating [5]

However, the reality of 21st-century learning demands is still far from the desired expectations, especially in physics learning. Some research results mention the gap between expectations and stickiness in the learning process. First, knowledge is still conventional [6]. Second, students are still not active and have not been directly involved in physics learning. The three learning processes are still student centre [7]

The level of student learning achievement in physics subjects is still low compared to other topics [8]. The problem description follows the results of the PISA study in 2018. Indonesia is ranked 71st in the 9th position from the bottom for the Science category [9]. Because the literacy of students in Indonesia is still low due to the limited integration of literacy in learning [10]

One solution that can be used to overcome these problems is to use a learning model following the objectives of learning in the classroom. A learning model is an approach, strategy and technique to achieve learning objectives. The learning model has steps to help implement learning to be better, coherent and directed [2]. One learning model that fits the demands of the 21st century is cooperative learning.

Cooperative learning is a learning model that uses a small grouping system with different academic backgrounds. The individual's success is determined or influenced by the success of the group [11]. Cooperative learning allows students to work together to achieve learning objectives [12]. So whether the learning is successful or not depends on the cooperation that the group has carried out

Some of the advantages of using a cooperative learning model can be seen from previous researchers. First, collaborative learning models can improve student physics learning outcomes [13]. Both suitable learning models can increase student learning activities [14]. Third, applying cooperative learning models can improve students' mastery of physics concepts [15]. In addition, the influence of this model on physics learning can increase students' creativity and scientific attitudes [16]. So the application of the cooperative learning model has a positive influence on the learning process and outcomes

Based on this description, the author is interested in conducting a meta-analysis of cooperative learning models on students' physical knowledge aspects. This study aims to determine the influence of suitable models on aspects of students' biological knowledge regarding the types of cooperative learning models. The second is to see the magnitude of the impact of the collaborative model on aspects of students' physics knowledge in terms of class level. Third, to know the extent of the influence of cooperative models on aspects of students' physical expertise in material groupings.

RESEARCH METHODS

This type of research is meta-analysis research. Meta-analysis was conducted on 20 national articles on cooperative learning models in physics learning. The purpose is to determine the magnitude of the influence on aspects of the learner's knowledge.

The magnitude of the influence (effect) can be determined according to the following statistical parameters of Bekcer & Park. The parameters that the author uses to find the effect size are as follows

1. Average in one group

$$ES = \frac{\bar{X}_{post} - \bar{X}_{pre}}{SD_{pre}}$$

2. Average in each group

$$ES = \frac{\bar{X}_{eksperimen} - \bar{X}_{control}}{SD_{control}}$$

3. T count

$$ES = t\sqrt{\frac{1}{n_{experiment}} + \frac{1}{n_{control}}}$$

Once the effect size is obtained, the effect size criteria are according to Diancer in Table 1.

Table 1. Effect Size Criteria

ES	Category
ES ≤ 0,15	Very low
0,15< ES ≤ 0,40	Low
0,40< ES ≤ 0,75	Keep
0,75< ES ≤ 1,10	High
ES >1,10	Very high

(Source: Asti, 2018)

RESULTS AND DISCUSSION

Twenty articles that have been analyzed are coded Ar1-Ar20. Each piece is grouped by its type. For the results of the effect size analysis of each article, see Table 2. The results of the effect size calculation of the 20 pieces are classified into three categories.

The first is based on the type of cooperative learning model. The types of suitable learning models analyzed in this study are thinking pair share (TPS), Jigsaw, Group Investigation (GI), and student team achievement divisions (STAD) can be seen in Table 3. The second grade based on class levels, namely class X, XI and XII, can be seen in Table 4. The third is based on the grouping of materials. The material in the article analyzed is Magnitude and Measurement, Motion, Temperature and Calorific Efforts of Fluid Energy Global Warming Dynamic Electricity, as seen in Table 5.

Table 2. Code, Journal Source, Effect Size and Formula used in Aspects of Knowledge

Code	Journal Sources	*Effect Size*	Formula
Ar1	Pratiningsih Juliana audina, 2018 [17]	2.35	Fr-2
Ar2	Nida, I GD W, 2014 [18]	8.41	Fr-1
Ar3	Rizkiah, musa'adatul, 2017 [19]	0.92	Fr-2
Ar4	Trisianawati, Eka, 2016 [20]	0.44	Fr-2
Ar5	Susilo fuadi, 2016 [16]	0.79	Fr-1
Ar6	Agustine, Yenni dan Shovia insyany, 2016	4.30	Fr-1
Ar7	Fahmi, Diana, 2016 [21]	0.74	Fr-2
Ar8	Siregar, Evitamala dan Mara Bangun, 2016 [22]	0.48	Fr-3
Ar9	Juraini, Muhammad Taufik, dan Wayan Gunada, 2016 [23]	0.83	Fr-2
Ar10	Agustin Putri Nuraini, 2017 [24]	0.76	Fr-2
Ar11	Pakpahan Rini Anggraini, 2019 [25]	2.24	Fr-3
Ar12	Limbong, Dian, 2017 [14]	0.39	Fr-2
Ar13	Ismari, Izatul, I ketut Mahardika dan Alex Harijanto, 2017 [26]	2.22	Fr-2
Ar14	Widiawati, Siska, 2018 [27]	0.86	Fr-2
Ar15	Amalia Ratih Habiba, 2016 [28]	0.42	Fr-2
Ar16	Sari Hartika Nova, 2019. [29]	2.04	Fr-2
Ar17	Susanto, Irwan, 2020 [30]	0.47	Fr-2

Ar18	A18 Verawati NYSP, 2020 [15]	0.88	Fr-1
Ar19	Idaramatasia, 2017 [13]	0.32	Fr-1
Ar20	Riswan, 2020 [31]	1.52	Fr-3

Influence of Cooperative Learning Models by Type

The results of the effect size analysis based on the type of cooperative model are divided into four groups, namely TPS, Jigsaw, GI and NHT. The TPS type consists of 4 articles, and the Jigsaw has six. The GI type consists of 4 pieces, while the STAD consists of 6 articles.

The average effect size results obtained can be seen in table 3. The TPS type consists of Ar1 Ar2 Ar3 Ar 16. type JIGSAW consists of Ar4, Ar5, Ar6, Ar17, Ar18 dan Ar20. Type GI consists of Ar7, Ar8, Ar12 dan Ar14. type STAD consists of Ar9, Ar10, Ar11, Ar15 and A19.

Table 3. Grouping Effect Size by Cooperative Model Type

Type	Journal Code	Average ES	Category
TPS	Ar1	3.43	Very High
	Ar2		
	Ar3		
	Ar16		
JIGSAW	Ar4	1.40	Very High
	Ar5		
	Ar6		
	Ar17		
	Ar18		
	A20		
GI	Ar7	0.61	Keep
	Ar8		
	Ar12		
	Ar14		
STAD	Ar9	1.31	Very High
	Ar10		
	Ar 11		
	Ar13		
	Ar15		
	Ar19		

Based on the calculation of the effect size obtained, it can be seen that for the TPS type, Jigsaw and STAD type are in the very high category, while for the GI type, it is in the medium category. However, for the average ES, the highest obtained by the TPS type was 3.43, the second was Jigsaw at 1.40, and the third was STAD at 1.31. The lowest average ES value was obtained by Type GI but is still in the medium category. Shows that the influence of the cooperative learning model in the four types analyzed is very effective on learning outcomes, especially knowledge of physics.

Follow the research that several previous researchers have carried out that using a TPS-type cooperative model can improve the achievement of learning physics for students, be it knowledge, skills or attitudes [18]. In addition, the influence of the TPS-type cooperative model can improve the learning outcomes of students' physics [32]. So the use of TPS-type suitable learning models in physics learning has a very strong influence on students' physics knowledge

Influence of Cooperative Learning Models by Grade and Material Levels

The results of the ES calculation based on class levels are divided into three groups, namely class X, XI and XII. For the calculation results, the highest average ES is class XI, the second is class X, and the last is class XII, which can be seen in the following table 4.

Table 4. Grouping Effect Size by Class

Class	Article Code	Ice Average	Categories Ice
X	Ar1	1.63	Very High
	Ar2		
	Ar3		
	Ar4		
	Ar7		
	Ar8		
	Ar10		
	Ar12		
	Ar13		
	Ar15		
	Ar16		
	Ar17		
XI	Ar6	1.68	Very High
	Ar11		
	Ar14		
	Ar18		
	Ar19		
	Ar20		
XII	Ar5	0.81	High
	Ar9		

Based on table 4, it can be seen that the application of cooperative learning models based on grade levels effectively influences students' physics knowledge. The highest average ES is in class XI with a score of 1.68, then class X with an average of 1.63, and then class XII with 0.81. So cooperative learning by grade level has the most effective influence on class XI. Corresponds to the calculation of the average ES obtained based on the grouping of materials in table 5.

Table 5. Grouping Effect Size by Material

Material	Article Code	Ice Average	Category
Quantity and Measurement	Ar4	0.98	High
	Ar16		
	Ar17		
Motion	Ar3	1.19	Very High
	Ar10		
	Ar13		
	Ar18		
Temperature and Heat	Ar1	2.48	Very High
	Ar2		

	Ar7		
	Ar8		
	Ar15		
Energy Business	Ar6	2.34	Very High
	Ar12		
Fluid	Ar11	1.14	Very High
	Ar14		
	Ar19		
Global Warming	Ar20	1.52	Very High
Dynamic Electricity	Ar5	0.78	High
	Ar9		

From the calculation of the average ES based on table 5, it can be seen that the highest ES value in Temperature and Heat matter is 2.48, which has a difference of 0.14 value with energy business matter. The lowest average ice calculation result is a dynamic electrical matter of 0.78. However, the results of calculating the moderate ES based on grouping these materials are not in the medium and low categories. So the influence of cooperative learning in a material grouping is in the high and very high categories. To see the difference in the average ES from the three aspects reviewed can be seen in figure 1 below.

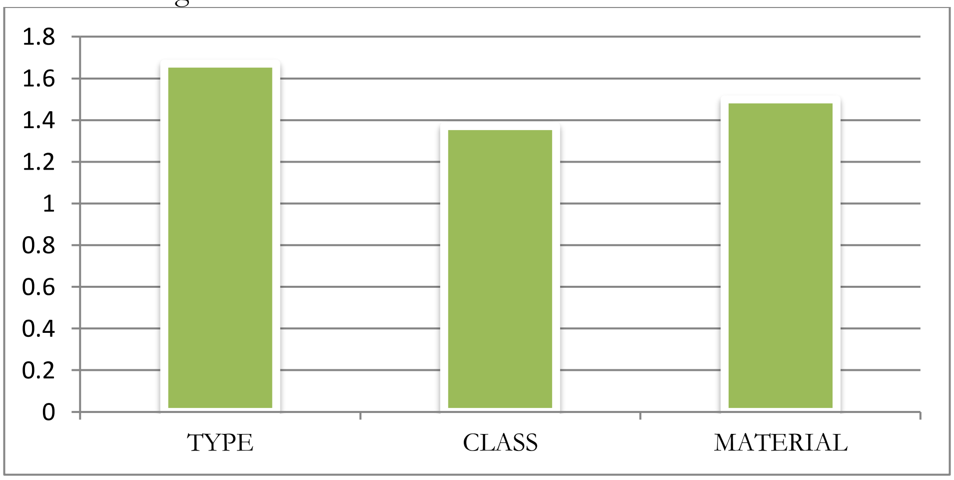

Figure 1. Comparison of ES in terms of Type, Class, and Material

Figure 1 shows that the influence of the cooperative model with the highest average ES in terms of the types of suitable models is 1,67. Then in terms of material, it is 1.50. The average score of Ice is the lowest in the class grouping, which is 1,37. However, all of them are in the very high category. Shows that the influence of cooperative learning models in terms of type, class and material strongly impacts students' physics knowledge.

CONCLUSION

Based on the data presented in this study, the results of this study can be stated. First, the influence of cooperative learning models in terms of the types of suitable models on students' physical knowledge has a very strong effect. Secondly, the use of the collaborative learning model in the grade level in high school has a very great influence.

The three learnings using a cooperative model in physics material on students' knowledge have a great influence. So learning using the collaborative model is most effective when viewed from the type of suitable model. This study only examines various kinds of cooperative learning models. Hopefully, in the next research, more styles will be used, such as Number Head Together (NHT), Team Accelerated Instruction (TAI), Inside Outside Circle (IOC) and others.

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