The Effect of Cooperative Learning Models on Learning Outcomes: A Second-Order Meta-Analysis

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Abstract

Cooperative learning is a learning model in which students support each other's learning in cooperation with each other. In the cooperative learning model, the education process has many advantages in terms of academic, social, psychological, measurement-evaluation, and economic aspects. In this study, which examines the effect of cooperative learning on students' learning outcomes, 23 first-order meta-analysis studies revealed the effects of cooperative learning model-based teaching on students' learning outcomes between 2010-2021, and 23 effect sizes from these studies were combined with the second-order meta-analysis method. In the study, teaching style, performance types, teaching level, research area, publication quality, publication bias status, report types, and location where the research was conducted were considered moderator variables. As a result of the study, it was determined that the effect of cooperative learning models on student outcomes was moderate. It was also revealed that the levels of cooperative learning outcomes for different domains differ. It has been determined that cooperative learning is also an essential factor in student outcomes. In addition, this study determined that the location of the meta-analysis studies was an important factor in the average effect sizes. Suggestions were made in line with the results of the research.

Keywords: Cooperative learning, student outcomes, second-order meta-analysis

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Introduction

In recent years, studies in the field of education have revealed new information and principles regarding the learning phenomenon, which has led to the emergence of new paradigms. These new paradigms bring different perspectives to learning. These perspectives develop and mature over time and construct self-consistent learning theories. These theoretically accepted learning theories are put into practice with the help of various learning models, methods, techniques, and principles due to different reflections. One of the most popular of these learning approaches is active learning.

Active learning saves students from being passive observers and observers in the learning process and puts them at the center of the learning process (Kalem & Fer, 2003). In this respect, active learning can be described as a learning process in which students can make decisions and self-regulate different aspects of learning. Students take responsibility for the learning process and are forced to use their mental skills during learning with complex instructional practices (Açıkgöz, 2014). With active learning, students are provided to associate the knowledge they have acquired with what they already have. They are supported to produce solutions to the problems they encounter in daily life with what they have learned. Active learning, which supports students' decision-making and high-order thinking skills, also provides students with the opportunity to direct the learning process and be in cooperate (Açıkgöz, 2014; Bear, 2013; Kalem & Fer, 2003). One of the essential learning models and approaches that allow active learning to be reflected in the learning process can be expressed as the cooperative learning model.

Cooperative Learning Model

Cooperative learning is a learning model that attracts more and more attention in many countries (Açıkgöz, 2014). The most critical indicators are; the high number of studies on cooperative learning, the intensity of the activities carried out on the subject and the large number of participants in these activities. Similarly, the cooperative learning model attracts attention because it is student-centered and the students actively participate in today's understanding of education. Cooperative learning is a student-centered model that supports active learning, allowing students to adapt to this role quickly. Many different definitions of cooperative learning are encountered when the relevant literature is examined. For example, Johnson et al. (2013) defined cooperative learning as instructional practices in small groups in which students work together to maximize their learning and that of their friends. In another definition, collaborative learning is defined by Christion (1990) as a learning approach in which students focus on learning a subject by working in small groups in line with a common goal to perform a task or solve a problem given to them. According to Felder and Brent (2007), cooperative learning is a learning method that maximizes students' learning while having fun. As a result of the instructional practices specified in the content of the definitions, cooperative learning enables students to construct different perspectives by supporting them to go through important

learning processes such as problem-solving, critical thinking, and reasoning (Borich, 2017; Gillies et al., 2010). Again, based on the definitions, it is seen that the most crucial feature of cooperative learning is that students work in small groups around a common goal by helping each other learn. In this respect, cooperative learning is similar to group work in cluster studies applied in traditional classrooms, but it is fundamentally different from cluster studies.

Taking its place in the literature as the characteristics of cooperative learning, positive commitment, individual responsibility, creation of groups and group spirit, teacher role, use of social skills, face-to-face interaction, and rewards distinguish this model from traditional cluster studies. For example, in positive commitment, which is considered a characteristic of cooperative learning, students know that the success of their groupmates will affect their success and that their success will affect the success of their groupmates (Öztürk, 2017). In addition, group goals were created to oblige students to deal with other students' competencies and their competencies (Doymuş & Doğan, 2013). In traditional cluster studies, group members can work independently of each other, and there is no dependency between them. In terms of positive commitment and all other cooperative learning features, cooperative learning groups differ from traditional cluster groups.

Many methods and techniques enable the implementation of cooperative learning, a process-based model that improves students' thinking skills (Açıkgöz, 2014; Kayacan, 2017). These methods and techniques are used by considering students' readiness, interests, and abilities; they differ according to the learning goal, the size of the classroom, the social and physical structure of the classroom environment, and the subject of the lesson to be applied (Aziz & Hossain, 2010; Colosi & Zales, 1998; Okumuş & Doymuş, 2018; Öztürk & Doymuş, 2018; Thurston et al., 2010). Among the methods and techniques related to the application of the principles and features of the cooperative learning model; are student teams-achievement sections, learning together, team-game-tournament, literacy-writing-practice, combined cooperative reading and composition, group research, collaboration-cooperation, academic conflict, team-assisted individualization, jigsaw methods, let's ask together, learn together and mutual questioning (Öztürk, 2017). Although these cooperative learning methods and techniques have a wide range due to some differences in application and evaluation, the aims and characteristics of the methods and techniques are similar.

When the relevant literature is examined, it is emphasized that the cooperative learning model has important benefits for teachers, students, and education systems. Thanks to the academic, social, psychological, assessment-evaluation, and economic benefits of cooperative learning, cooperative learning has been accepted as an important part of educational practices in recent years (Öztürk, 2017). Since cooperative learning is a model that enables students to take responsibility for their work, requires them to be active in the learning process, and supports this, students absorb the information themselves in the process and see the benefits of working together academically (Açıkgöz, 2014;

Huang et al., 2011). In the applications of this model, students exchange ideas while working together. In this way, the model also supports the development of different thinking skills of students (Slavin, 1992). Students who carry out the learning process together can find a response to their differences by structuring their learning, reinforcing what they have learned, and completing their deficiencies. As a result, they learn while teaching (Ekinci, 2011).

Many studies have shown that cooperative learning has significant and positive effects on students' academic success by providing permanent and conceptual learning, supporting scientific process skills, and putting the learning responsibility on the student (Acar & Tarhan, 2008; Barbosa et al., 2004; Gradel & Edson, 2010; Karacop & Doymuş, 2012; Okumuş & Doymuş, 2021; Öztürk & Doymuş, 2018; Peterson & Miller, 2004; So & Ching, 2011; Torrego-Seijo et al., 2021). Similarly, in cooperative learning, since students are in constant interaction, their communication skills improve (Serrano & Pons, 2014) and they begin to express themselves better (Saban, 2013), their sense of responsibility and trust towards each other increases (Demirel, 2015; Eshietedoho, 2010), skills such as looking at events from a different perspective, empathizing, and acting together in the fight against difficulties are supported (Öztürk, 2017). In this way, while cooperative learning strengthens the social aspects of students (Eilks, 2005; Gillies & Boyle, 2010; Zentall et al., 2011), it also positively affects students psychologically (Slavin, 1990; Tok, 2013; Vijayaratnam, 2012). In cooperative learning, which is a process-oriented model rather than a result-oriented model, many different measurement-evaluation techniques such as observation and evaluation of groups, individual or group quizzes, preparation of group projects, written and oral exams are used (Koçak, 2008; Santos Rego & Lorenzo Moledo, 2005). While using different and alternative techniques in cooperative learning makes reaching all students easier, it also allows each student to be evaluated according to their learning style (Falk, 2012). Compared to other teaching methods and techniques, cooperative learning is characterized as a model that can be applied more effectively and economically, especially in schools where equipment is inadequate because students work together in cooperative learning (Jolliffe, 2010; Öztürk, 2017).

Current Study

When the literature on the cooperative learning model is examined, it is seen that the variety and benefits of the methods and techniques used for the application of the model draw attention, especially the effect of the model on the learning outcomes. In this sense, it is noteworthy that there are intense studies on both the singular (Okumuş & Doymuş, 2021; Öztürk & Doymuş, 2018; Thomas & Martina, 2022; Torrego-Seijo et al., 2021) and meta-analysis level, in which the effect of the cooperative learning model on learning outcomes is tried to be determined. However, although the individual and meta-analysis studies made significant contributions to the relevant literature, the need for more comprehensive studies investigating the effect of the cooperative learning model on learning

outcomes continues. In line with this need, it is considered that it is important to examine different meta-analysis studies in the literature together and synthesize their results. In this direction, it is aimed to synthesize the findings of the first-order meta-analysis studies investigating the effect of the cooperative learning model on learning outcomes in this study with the second-order meta-analysis. In addition, it is anticipated that the study will contribute to the literature in terms of revealing which skills the model contributes to the development of individuals, as well as reflecting the effect of the cooperative learning model on learning outcomes. Due to these qualities, it is aimed that the study will enable teachers and prospective teachers to see the nature of the cooperative learning model, examine the effect of the model on learning outcomes comprehensively, and guide program development studies by providing more comprehensive data on cooperative learning. In line with the stated objectives, this study sought answers to the following research questions:

1. What is the effect of cooperative learning models on learning outcomes?

2. Does the effect of cooperative learning models on learning outcomes differ according to moderator variables?

Method

The second-order meta-analysis method was adopted in this study to examine the effect of cooperative learning on student learning outcomes. The second-order meta-analysis method is a meta-analysis of meta-analysis studies (Schmidt & Oh, 2013). While first-order meta-analysis studies are used as primary research data, meta-analysis research is used in second-order meta-analysis research. Second-order meta-analysis studies combine the statistical findings of meta-analysis studies (Oh, 2020).

Data Collection

The data of this study were accessed using Web of Science, Scopus, ERIC, Academic Search Ultimate, and Google Academic databases. Searches were made in the mentioned databases using the keywords cooperative or collaborative or team learning, group learning, peer learning, and meta-analysis or meta-analytic. The titles and abstracts of the studies produced by the databases were examined according to the predetermined inclusion criteria.

Inclusion Criteria

1. Meta-analysis studies must have been published in English between 2010-2021.

2. Meta-analysis research should focus on cooperative learning models and student outcomes.

3. The research covered by meta-analysis studies should be researched in experimental design. The control group of research covered by meta-analysis research should be traditional or lecture-based teaching methods.

4. Meta-analysis studies should contain sufficient statistical data to calculate the generic effect size. (e.g., Cohen's d, Hedge's g and lower limit (LL), the upper limit (UP), standard error (SE), and variance value depending on these effect sizes).

5. The overlap rate between meta-analysis studies should be at most 25%. If the overlap rate is less than 25%, it is accepted that meta-analysis studies are independent (Cooper & Koenka, 2012). In case of overlap, up-to-date and comprehensive meta-analysis research was preferred. Studies excluded due to overlap are presented in Appendix 1.
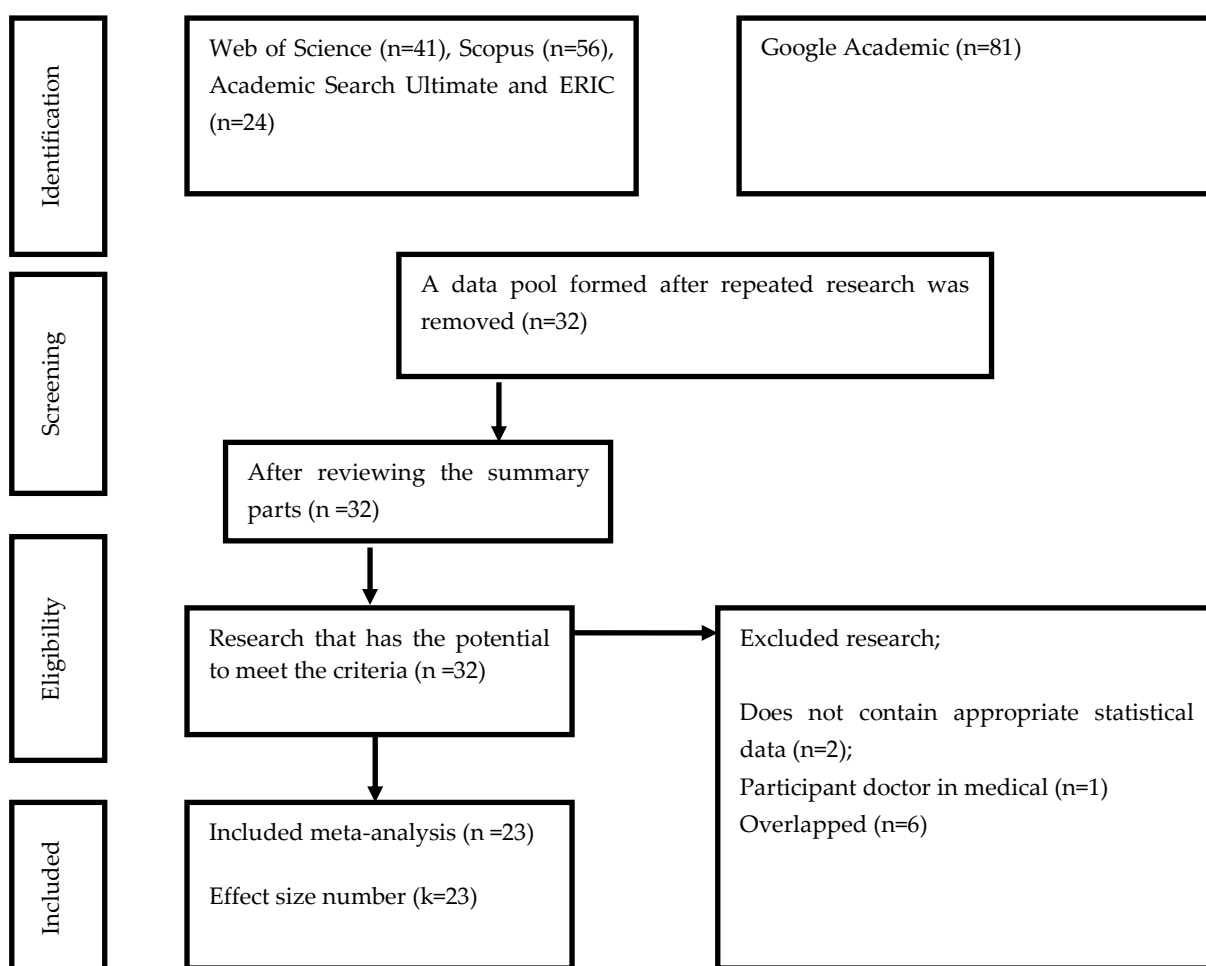

Figure 1. Data-flow chart

A data pool was created from 32 potential studies that met the inclusion criteria for this study. After examining the content of the studies that made up the data pool, nine studies that did not meet the inclusion criteria were excluded. Thus, the data set of this study consisted of 23 meta-analysis

studies. The data flow diagram for the formation of the data set is presented in Figure 1. On the other hand, the characteristics of the studies that make up the data set of this study are presented in Appendix 2.

Coding

This study used a coding form reflecting the characteristics of meta-analysis studies. The coding form includes the identifier and features of meta-analysis research. Table 1 presents coding information.

Table 1. The identifier and features of meta-analysis research

Group	Code
Cooperative learning model	Computer-supported and face to face
Grade Level	K12, higher and mixed
Outcomes	academic achievement and combined
Domain	Language, STEM*, medical and mixed
Primary research report type	article and mixed
Location	China, Türkiye, others (Indonesia, Iran), and mixed,
Meta-analysis quality	insufficient, weak, medium, and high
The state of bias	yes, no, and NA

    * STEM = Science, Technology, Engineering, and Mathematics

Quality Assessment

The Revised Assessment of Multiple Systematic Reviews (R-AMSTAR) scale was used to evaluate the quality of meta-analysis studies (Kung et al., 2010). R-AMSTAR is a scale prepared for the medical field. R-AMSTAR consists of 11 items. Items 8A and 8B are items that cover clinical applications; For this reason, it was not taken into consideration. Young (2017) was referenced when evaluating the R –AMSTAR scale scores.

Statistical Independence

Only effect sizes depending on the experimental research group were used if the studies included experimental and relational models. If the studies contain effect sizes related to more than one learning outcome, the average effect size produced by the research was calculated. This situation is preferred because only k=2 of meta-analysis studies reported independent effect sizes related to student outcomes. Other meta-analysis studies included k=11 combined effect sizes; If k=10, it reported the effect size of single student output. In addition, since the analysis unit in this study is at the research level, an effect size represents each meta-analysis research.

Statistical Model

Suppose the samples of the studies used in meta-analysis studies are different and different from each other in terms of characteristics. In that case, it is recommended to use the random effect

model. (Borenstein et al., 2011). The random effect model was preferred for statistical analysis in this study since meta-analysis studies came from different samples. On the other hand, the analysis unit of this study is at the research level. In other words, each meta-analysis research is represented by effect size.

Effect Size Calculation

One of the studies (k=1) that formed the data set of this study reported Fisher's z as effect size and one (k=1) reported Pearson correlation coefficient (r) as effect size. These effect sizes were converted to d values. On the other hand, k=14 meta-analysis research g value; If k=9 (with k=2 converted from different indices), the d value is reported. Since g is used more frequently as an effect size index in this study, the g value is preferred as a generic effect size. On the other hand, Cohen's (d) and Hegde's (g) effect size calculation methods produce the same result in large samples (Marfo & Okyere, 2019; Turner & Bernard, 2006). Marfo and Okyere (2019) and Goulet-Pelletier and Cousineau (2018) state that the g value in small samples is the adjusted value of d. Considering the above explanations, it is accepted that d and g values can be combined in this study. In addition, it was assumed that the sample size of the primary studies covered by meta-analysis studies was sufficient. Second-order meta-analysis studies are carried out with similar assumptions (Hew et al., 2021; Tamim et al., 2011; Young, 2017).

Publication Bias Analysis

The reliability of the average effect size produced by the data set is related to publication bias. For this reason, various publication bias analysis techniques have been developed (Borenstein et al., 2011). In this study, funnel plot graph, classic fail-safe N, Egger's test, and Duval & Tweedie, trim and fill (DTTF) analysis techniques were used (Jin et al., 2014).

Heterogeneity and Moderator Analysis

Q statistics were used to determine the data set's heterogeneity. The I^2 test was used to determine the heterogeneity level of the data set. On the other hand, effect sizes were calculated according to moderator variables (Table 1). Whether the effect size differed according to the moderator variables was checked with the Q between tests.

Findings

Descriptive statistics are presented with mean effect size, publication bias, heterogeneity, and the data set's moderator analysis.

Descriptive Statistics and Average Effect Size

The total number of primary studies covered by the meta-analysis studies that make up the data set is 684—the effect sizes of the meta-analysis studies that make up the data set range from ES=.23 to ES=2.55. The average effect size produced by the data set was ES=.73 (LL=.60 UP=.85). The effect of cooperative learning models on learning outcomes is moderate. The total heterogeneity of the data set was calculated as Q=298.47 (p<.01). In other words, the heterogeneity level of the data set is high (I^2=92.63).

Publication Bias Analysis

When the funnel plot graph of the data set is examined, it can be proposed that the distribution of effect sizes according to their standard errors is approximately symmetrical. The two studies with a significant standard error and a large effect size in the lower right corner of the funnel plot graph broke the symmetry. Egger's regression test results showed publication bias (t=4.50 p<.01). Conversely, the classic fail-safe test result was N=6451. If the calculated N value is 5k+10= 23.5+10=125, it can be assumed that the effect size is reliable (Rosenthal, 1991). This study's calculated N value is very high (6451>125). In other words, a meta-analysis study with 6451 p < .05 is needed for the calculated mean effect size to be invalid. In addition, insignificant publication bias was found at the end of the DTTF test. According to the DTTF test, it was found that the distribution of effect sizes according to their standard errors would be symmetrical by adding k=1 studies to the left of the mean effect size. The funnel plot graph according to the DTTF result is presented in Figure 2.
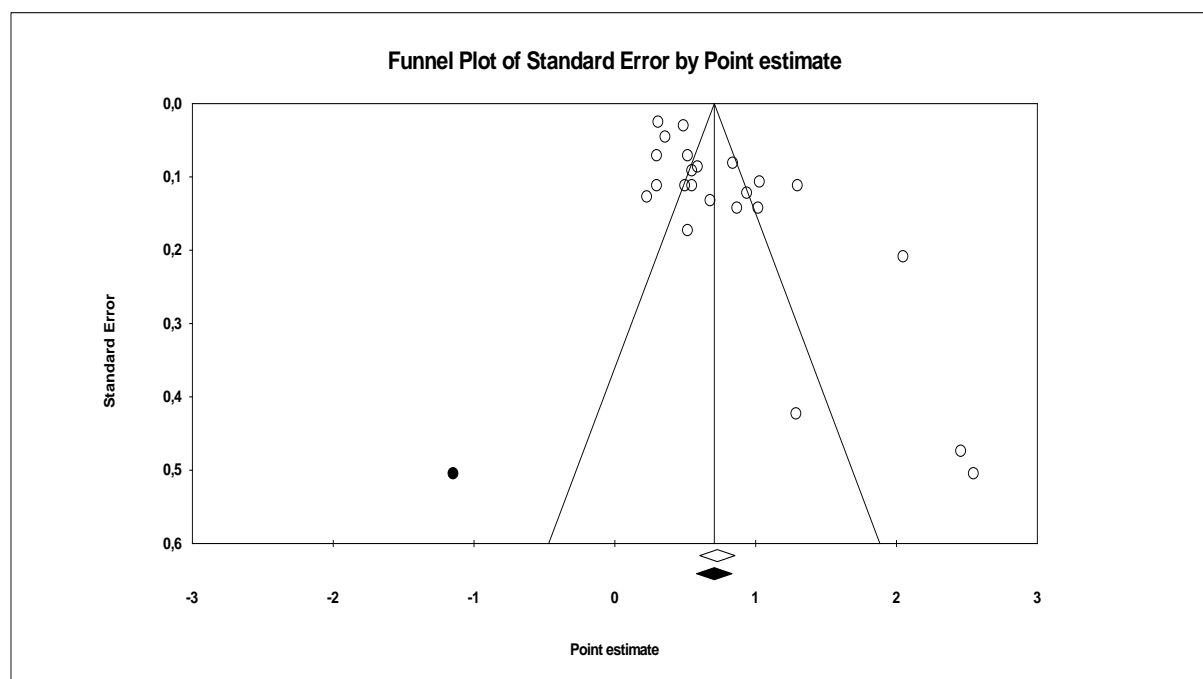
*Dark dot, k=1 meta-analysis research, which should be added to the left of the mean

Figure 2. Funnel plot of the dataset

Adjusted effect size value ES=.71 (LL=.58 UL=.83) according to DTTF test result. The difference between the observed and adjusted mean effect sizes is approximately ΔES = .01. It can be said that this value is insignificant. Considering the results of the classic fail-safe test and DTTF test regarding the data set, it can be proposed that it contains a little publication bias.

Heterogeneity and Moderator Analysis

In Table 2, heterogeneity and moderator analyses of the data set are presented. The remarkable findings are as follows.

Table 2. Heterogeneity and moderator analysis of the dataset

Group	k	ES	LL	UL	Q(b)	df (Q)	p
Cooperative Learning Model							
Computer support	3	.53	.18	.89			
Face to face	20	.78	.63	.93	1.58	1.00	.21
Outcomes							
Achievement	10	.75	.57	.93			
Combined	13	.70	.53	.86	.16	1.00	.69
Domain							
Medicine	7	1.17	.91	1.42			
STEM	5	.56	.34	.79			
Language	3	.82	.51	1.12			
Psychology	1	1.02	.47	1.57			
Mixed	7	.50	.31	.68	20.85	4.00	.01*
Level							
Higher	11	.91	.71	1.12			
K12	2	.43	.00	.85			
Mixed	10	.64	.46	.83	5.84	2.00	.05
Location							
China	3	2.03	1.45	2.62			
Türkiye	2	.93	.59	1.27			
Other	2	.80	.45	1.15			
Mixed	16	.61	.49	.73	24.18	3.00	.01*
Quality							
Higher	13	.77	.59	.95			
Medium	10	.69	.51	.88	.35	1.00	.55
Bias							
No	14	.74	.58	.89			
Yes	7	.63	.40	.86			
Unknown	2	.90	.50	1.30	1.39	2.00	.50
Report							
Article	13	.81	.63	1.00			
Mixed	10	.65	.46	.84	1.47	1.00	.23

*p<.05

The effect of cooperative learning on learning outcomes differs according to teaching fields (Q (4) = 20.85 p<.01). The impact of cooperative learning on learning outcomes in medicine, psychology,

and language fields are high (ES=1.17, ES=1.02 ES=.82 respectively). If the meta-analysis studies are mixed-field focused, the average effect size is medium (ES=.50).

The effect of cooperative learning on students' learning outcomes differs according to the locations of meta-analysis studies (Q (3) = 24.18 p<.01). The average effect sizes of the meta-analysis studies with Chine locus were relatively high (ES=2.03). The average effect sizes of meta-analysis studies covering Türkiye and other countries (Indonesia and Iran) are high (ES=.93 ES=.80, respectively). On the other hand, the average effect size of mixed meta-analysis studies covering many countries is medium (ES=.61).

It was also accepted that the effect of cooperative learning on learning outcomes differed statistically according to education level (Q (3) = 5.84 p=.05). While the average effect size is high at higher education levels, it is low at the K12 level (ES=.91, ES=.43). On the other hand, if the meta-analysis studies cover varied levels, the average effect size is medium (ES=.64). In addition, it was observed that the average effect sizes of meta-analysis studies did not differ statistically according to CLM, learning outcome type, quality level, publication bias status, and basic research type.

Discussion, Conclusion and Recommendations

Discussion

Cooperative learning; It is a learning model in which students support each other's learning in cooperation with each other. Its advantages, which are classified as academic, social, psychological, assessment-evaluation, and economic, have made cooperative learning prevalent in educational practices in recent years (Öztürk, 2017). In this respect, the effect sizes obtained from first-order meta-analyses examining the effect of cooperative learning on students' learning outcomes were combined in this study. As a result of this research, it was determined that the impact of cooperative learning models on student outcomes was moderate. When the literature is examined, it is seen that there is no second-order research examining the effect of cooperative learning on students' performance. Gillies (2016) stated that cooperative learning would produce learning outcomes such as facilitating the academic success of others, helping unsuccessful children overcome their lack of motivation, developing positive attitudes towards others, and improving each other's communication skills. In this direction, it is seen that cooperative learning has a positive effect on students' performance and other learning outcomes.

The cooperative learning model is an effective method used to positively improve student outcomes at all grade levels and in all courses (Bayrakçeken et al., 2013; Çetinkaya & Durmuş, 2021; Okumuş et al., 2019). Studies on using the cooperative learning model in the teaching process have been categorized according to different variables. The categorization enabled the comparison of the effect of the cooperative learning model on student performance in terms of different variables. In this

regard, the effect of cooperative learning on student learning outcomes was examined in this study, including teaching style, performance types, teaching level, research area, publication quality, publication bias status, report types, and the location of the research was conducted as moderator variables.

As a result of this research, it was revealed that the learning domain is a moderator variable in meta-analysis studies examining the effect of cooperative learning on students' learning outcomes. In line with the findings, it has been revealed that the effect of cooperative learning models on learning outcomes in medicine, psychology, and language fields is high and moderate in the STEM field. The cooperative learning-teaching approach is an innovative learning-teaching approach that can be used to increase the quality of learning, provides individuals with the opportunity to acquire many social skills such as leadership, joint decision-making, communication, building mutual trust and solving in-group problems, and can be adapted to all learning environments (Johnson et al., 2016). In this direction, the level of learning outcomes of students can be higher when the cooperative learning model is used in areas that require cooperation. The use of cooperative learning is also necessary for the fields of medicine, psychology, and language, where many social skills, such as building mutual trust, decision-making, and communication are required. In this respect, the high level of cooperative learning in these areas may be due to this.

As a result of the collaborative teaching process, students from primary school gain many gains, such as creating a product together, sharing experiences while developing these products, and socializing. This situation enables students to socialize together with their academic success (Arısoy & Tarım, 2013; Gelici & Bilgin, 2011; Okumuş, 2020; Şimşek et al., 2006; Yıldız et al., 2017). As a result of this research, it was determined that cooperative learning is an essential factor in students' learning outcomes. As a result of the research, it was concluded that the effect of cooperative learning on student outcomes is high at the higher education level and moderate at the K12 level. Some studies on cooperative learning reveal that its use at the higher education level is a practical approach to learning outcomes (Bushell, 2006; Pauli et al., 2008). Cooperative learning outcomes are higher in higher education levels because the necessity of research, cooperation, and joint work is higher than at other levels.

In this study, it was observed that the average effect sizes differed according to the location of the meta-analysis studies. China produced a very high effect size, Türkiye and other countries (Indonesia and Iran) had an increased effect size, while diverse countries produced a medium effect size. One of the bias problems in meta-analysis research is location bias (Higgins & Green, 2011). In other words, the reliability of the effect size is affected by the location covered by primary research. Vickers et al. (1998) showed that effect sizes differ according to the country's location in clinical practice. The same can happen in school applications.

Policy Implications

In the understanding of today's education, it is considered as an important issue that the information becomes meaningful and experiential for the individual rather than determining the level of knowledge of the individual. Considering the effect of the cooperative learning model on learning outcomes and the contribution it provides to the development of individuals in general, the reason why the model has been considered important in recent years by all stakeholders in education emerges. Because the cooperative learning model contributes to the individual making what they have learned before meaningful. When it is evaluated in terms of education policies shaped by closely following educational approaches at national and international levels, it is emphasized that by taking into account the development of individuals in the process, using the techniques and strategies in education policies is a must. Again, it is suggested as a result of the observations made during the education-teaching process that individual differences should be taken into account in today's education policies and some changes should be made when it is necessary. When it is evaluated in this context, it can be seen clearly that the cooperative learning model is a model compatible with today's education policies. At the same time, with the results obtained by aiming to see the nature of the cooperative learning model and to examine its effect on learning outcomes in a comprehensive way with this study, it is thought that the study is also important in terms of directing education policies and program development studies.

Conclusion

This research is a second-order meta-analysis study combining first-order meta-analyses that reveal the effects of cooperative learning model-based instruction between 2010-2021 on students' learning outcomes. As a result of this research, which aims to demonstrate the impact of cooperative teaching on students' learning outcomes, four significant results have emerged. First of all, as a result of the teaching processes based on cooperative learning, the student's learning outcomes are positively affected. Second, teaching based on a cooperative learning model in medicine, psychology, language, and STEM positively impacts students' learning outcomes. Third, it has been determined that using the cooperative learning model in higher education teaching processes is more effective than using it at other levels. In addition, it was observed that the average effect sizes differed according to the location of the meta-analysis studies. In the studies conducted for a single country to reveal the effect of cooperative learning, it has been shown that cooperative learning is more than mixed studies.

Recommendations

Cooperative learning has a positive effect on students' learning outcomes. In this direction, teachers should make arrangements based on the cooperative learning model in their classroom practices. Mainly, group work should be included to ensure cooperation in areas where mutual trust,

communication, and practice are necessary. Collaboration at higher education levels has been found to have a higher impact on learning outcomes. In this direction, it is helpful to direct students to cooperation and group work often. There are also some limitations in this study. This study is limited to studies published in English between 2010 and 2021. Second-order meta-analysis research can cover more extensive year ranges and different languages. In this research, the analysis unit is at the research level. For more detailed and analytical analyses (for example, according to learning product or teaching levels), second-order meta-analysis studies with different units of analysis can be done. On the other hand, this study covers only cooperative learning models from constructivist learning models. The effects of other constructivist learning models, such as problem-based learning, inquiry-based learning, case-based learning, and other learning models, on learning outcomes can be examined.

Conflict of Interest

The author declares that he has no conflicts of interest.

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Ethical Statement

Since the study was a meta-analysis study, ethics committee approval was not required.

Credit Author Statement

The author confirms that he had all responsibilities for the following: conceptualization of the study and design, data collection, data analysis and interpretation of the findings, and preparation of the manuscript.

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Appendices

Appendix 1

Studies excluded and selected due to overlap

exculed	inculed	outcome
Apugliese, & Lewis (2016)	Warfa (2016)	academic achievement
Vogel, et. al. (2017)	Jeong et. al. (2019)	combined
	Jeong et. al. (2019)	academic achievement
Wecker, & Fischer (2014)		
	Turgut, & Gülşen Turgut (2018)	academic achievement
Capar & Tarim (2015)		
Guraya, & Abdalla (2020)	Brierley et.al. (2021)	combined
Puzio, & Colby (2013)	Cole (2014)	academic achievement

Appendix 2

Study	ES	LL	UL	k	CLM	level
Talan (2021)	0,52	0,38	0,66	40,00	Computer-Supported Collaborative	mixed
Ngoc et. al. (2020)	2,05	1,64	2,46	11,00	Team-based learning (TBL)	higher
Lang et. al. (2019)	2,55	1,56	3,55	12,00	Team-based learning (TBL)	higher
Kaldırım, & Tavşanlı (2018)	1,03	0,82	1,25	32,00	Face to face Collaborative Learning	mixed
Jeong et. al (2019)	0,49	0,43	0,56	143,00	Computer-Supported Collaborative	mixed
Sung et. al (2017)	0,59	0,42	0,76	31,00	Mobile-Computer-Supported Collaborative Learning	mixed
Warfa (2016)	0,68	0,42	0,95	25,00	face to face Collaborative Learning	mixed
Swanson et. al (2019)	0,55	0,37	0,74	17,00	Team-based learning (TBL)	higher
Chen, et. al. (2018).	2,46	1,53	3,40	13,00	Team-based learning (TBL)	higher
Turgut, & Gülşen Turgut (2018)	0,84	0,68	1,00	47,00	Face to face Collaborative Learning	mixed
Pai et. al. (2015)	0,30	0,16	0,44	24,00	Small-Group Learning	mixed
Kyndt et. al (2013)	0,31	0,26	0,37	65,00	Face to face Collaborative Learning	mixed
Cole (2014)	0,55	0,33	0,77	28,00	Face to face Collaborative Learning	K12
Tomcho, & Foels (2012)	1,02	0,74	1,35	37,00	Group Learning	higher
Elabdali (2021)	0,87	0,59	1,15	10,00	Collaborative writing	mixed
Brierley,et. al. (2021).	0,52	0,18	0,85	21,00	Peer-assisted learning	higher
Choi et. al (2021)	0,23	-0,02	0,47	10,00	Peer Learning	higher
Zha et. al (2019)	0,36	0,27	0,46	28,00	Peer-led learning	higher
Balta et. al (2017)	0,94	0,70	1,17	29,00	Peer Instruction	mixed
Setiana et. al (2020)	0,30	0,08	0,56	16,00	Cooperative learning	K12
Shakerian, et. al (2020)	1,30	1,08	1,51	7,00	Jigsaw Cooperative Learning	higher
Wang et al (2021)	1,29	0,46	2,13	12,00	Team-based learning (TBL)	higher
Kalaian et. al (2018)	0,50	0,28	0,62	26,00	Team-based learning (TBL)	higher

Study	location	report	outcomes	quality	bias	domain	year range
Talan (2021)	mixed	mixed	academic achievement	medium	no	mixed	2010-2020
Ngoc et. al. (2020)	mixed	article	academic achievement	higer	no	medical	NA-2018
Lang et. al. (2019)	China	article	combined	higer	yes	medical	2013-2018
Kaldırım, & Tavşanlı (2018)	Türkiye	mixed	academic achievement	medium	no	language	NA-2016

Jeong et. al (2019)	mixed	article	combined	higer	yes	STEM	2005–2014
Sung et. al (2017)	mixed	article	combined	higer	no	mixed	2000-2015
Warfa (2016)	mixed	mixed	academic achievement	higer	no	STEM	2001-2015
Swanson et. al (2019)	mixed	article	academic achievement	higer	no	mixed	2000-2014
Chen, et. al. (2018).	China	article	combined	higer	no	medical	NA-2015
Turgut, & Gülşen Turgut (2018)	Türkiye	mixed	academic achievement	medium	no	STEM	2000-2017
Pai et. al. (2015)	mixed	mixed	combined	medium	yes	mixed	2000-2008
Kyndt et. al (2013)	mixed	article	combined	higer	yes	mixed	1995-2012
Cole (2014)	mixed	mixed	academic achievement	higer	no	language	1987-2011
Tomcho, & Foels (2012)	mixed	article	combined	higer	no	psychology	1974-2011
Elabdali (2021)	mixed	mixed	academic achievement	medium	no	language	2002-2019
Brierley,et. al. (2021).	mixed	article	combined	higer	yes	medical	NA-2021
Choi et. al (2021)	mixed	article	combined	higer	no	medical	1990-2019
Zha et. al (2019)	mixed	mixed	combined	medium	no	mixed	1993-2017
Balta et. al (2017)	mixed	mixed	combined	higer	yes	mixed	2000-2015
Setiana et. al (2020)	other	article	academic achievement	medium	no	STEM	2010-2020
Shakerian, et. al (2020)	other	article	combined	medium	unknown	medical	2010-2020
Wang et al (2021)	China	article	combined	higer	yes	medical	2012-2018
Kalaian et. al (2018)	mixed	mixed	academic achievement	medium	unknown	STEM	1995-2010