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Analysis of Constructivist Learning Model's Effects on Student Outcomes: A Second Order Meta-Analysis

Yapılandırmacı Öğrenme Modelinin Öğrenci Çıktılarına Etkisinin İncelenmesi: Second Order Meta-Analiz

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ABSTRACT: The effects of the constructivist-learning model on student outcomes are analyzed in this research study. For this purpose, the results of 19 meta-analysis research focusing on the effects of constructivist learning models on student outcomes are combined with the second-order meta-analysis method. The research included in the process had been carried out between the years 2015 and 2021. At the end of the research process, it is determined that the effect of constructivist learning models on student outcomes is medium level. On the other hand, it is determined that the effect of constructivist learning models on student thinking skills and academic success is high-level. Besides, it is found that the effect of constructivist learning models on student attitudes is medium level. At the end of the moderator analysis based on location, it is observed that the effects of constructivist learning models on student outcomes vary. Atelier studies can be carried out in education zones to develop teaching skills about the application of constructivist learning models. On the other hand, it is seen that studies on the issue mostly focus on academic success and attitude. Following this, the effects of constructivist learning models on the other student outcomes can be analyzed.

Keywords: Academic achievement, **c**onstructivist learning model, thinking skills, second order meta-analysis.

ÖZ: Bu araştırmada yapılandırmacı öğrenme modellerinin öğrenci çıktılarına etkisi incelenmiştir. Bu doğrultuda 2015-2021 yılları arasında, yapılandırmacı öğrenme modellerinin öğrenci çıktıları üzerindeki etkisini inceleyen 19 meta analiz araştırmasından elde edilen sonuçlar second order meta analiz yöntemiyle birleştirilmiştir. Araştırma sonucunda yapılandırmacı öğrenme modellerinin öğrenci çıktılarına etkisinin orta düzeyde olduğu sonucuna varılmıştır. Ayrıca yapılandırmacı öğrenme modellerinin öğrencilerin düşünme becerilerine ve akademik başarılarına etkisinin yüksek düzeyde olduğu sonucuna erişilmiştir. Öte yandan yapılandırmacı öğrenme modellerin öğrenci tutumlarına etkisinin orta düzeyde olduğu sonucuna varılmıştır. Lokasyona göre yapılan moderatör analizi sonucunda yapılandırmacı öğrenme modellerin öğrenci çıktılarına etkisinin farklılaştığı görülmüştür. Yapılandırmacı öğrenme modellerinin öğrenci çıktılarına etkisi dolayısıyla öğretmenlerin yapılandırmacı öğrenme modellerinin uygulamasına ilişkin becerilerini geliştirmek amacıyla eğitim bölgeleri düzeyinde atölye çalışmaları yapılabilir. Ayrıca yapılan çalışmaların daha çok akademik başarı ve tutum ile ilgili olduğu görülmektedir. Bu doğrultuda yapılandırmacı öğrenme modellerinin diğer öğrenci çıktıları üzerine etkileri incelenebilir.

Anahtar kelimeler: Akademik başarı, yapılandırmacı öğrenme modeli, düşünme becerileri, second order meta-analiz.

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Curriculums are made of the purpose, content, teaching/learning methods, education environment, education instruments, and assessment and evaluation elements. The steps of designing and implementing an efficient curriculum are closely related to the development of these elements (Batdı, 2021). In countries with centralized management, decision-makers have more efficient roles in the stages of designing, implementing, and evaluating programs; teachers, on the other hand, have more authority in deciding variables such as learning approach, method, model, instruments, and putting the activities into practice. School managers have more power in organizing learning-teaching environments, planning and controlling the education process when compared to other shareholders. In other words, the authority of school managers and teachers in countries that embrace central-management understanding is limited to determining teaching methods and the process of putting them into practice. However, the roles of school managers as the leaders of the teaching process are the most significant role as they assist in developing teaching and direct education processes (Gülbahar, 2014). The value and efficiency of programs used in schools are related to student outcomes after implementing the program (Kozikoğlu, 2014). In line with this purpose, in the systems that prioritize the understanding of centralized management, the efficiency of educational programs depends on the learning approach and models chosen by teachers for planning the teaching process.

The efficiency of the teaching process is closely related to activities that support student learning by discovery and experience; additionally, learning processes should be linked with the daily life of students (Ministry of National Education [MoNE], 2009, p. 8-9). Teachers should organize classes in line with the interest and needs of students to increase learning outcomes in the teaching process (Saracaloğlu, 2019; Şimşek, 2022). The efficiency of the learning and teaching process depends on the approach, method, and technique in which students are cognitively, affectively, and socially active (Toraman & Demir, 2016). Constructivist approach is one of the approaches in which students are active in the learning process and have the responsibility of learning. (Eskicioğlu, 2021).

Individual and meta-analysis studies about the effects of learning models that centralize the constructivist learning approach on student outcomes are carefully analyzed in the scope of this study. According to the findings, at the end of the teaching and learning processes based on constructivist learning model, the effects are on student outcomes, such as students' academic success (Akuma & Callaghan, 2019; Arık & Yılmaz, 2020; Ayaz & Şekerci, 2016; Bores-Garcia et al., 2021; Erişen & Günay, 2015; Hall & Quinn, 2014; Jamal et al., 2019; Semerci & Batdı, 2015; Şad et al., 2017; Zakaria et al., 2019), attitude (Akuma & Callaghan, 2019; Ayaz & Şekerci, 2016; Azer & Azer, 2015; Hall & Quinn, 2014; Jamal et al., 2019; Semerci & Batdı, 2015; Zakaria et al., 2019) and thinking skills (Musna et al., 2021; Şaşmaz-Ören & Sarı, 2019; Suparman et al., 2021). On the other hand, when the related literature is analyzed, it is seen that meta-analysis research (Demirel & Dağyar, 2016; Musna et al., 2021; Suparman et al., 2021; Yohannes et al., 2020), in addition to the basic research about the constructivist learning model, are quite common. When the meta-analysis studies about the effects of learning models based on the constructivist learning approach are analyzed, it is determined that their impact sizes are different from one another and this difference is big (*ES*=.45 and *ES*=1.20). In line with this, it is seen that it is necessary to

make a more comprehensive and detailed study for synthesizing the findings obtained from meta-analysis studies and using the obtained knowledge more efficiently. This research is important in terms of revealing the overall effect size of learning models based on the constructivist learning approach on students' learning outcomes.

Purpose

At the end of the literature analysis, it is encountered that no study combines the results of meta-analysis studies that focus on the effect of constructivist learning models on student outcomes. It is believed that this study will contribute to the literature about the effects of these learning models on student outcomes. In line with this purpose, this study aims to analyze the effects of constructivist learning models on student outcomes. The below-mentioned questions are asked in the scope of this research study.

1. What is the impact level of constructivist learning models on student outcomes?
2. Does the effect of constructivist learning models on student outcomes vary according to moderator variables?

Literature Review and Theoretical Framework

According to the constructivist approach, teachers do not directly transfer knowledge to students who are passive throughout the process; students are active in the process of constructing knowledge (Duman, 2013; Gökalp, 2019). Students compare new information to the older ones, create schemes if necessary and internalize knowledge (Genç, 2017; Güneş & Asan, 2005). In traditional teaching approaches, learning mostly occurs in the process of transmitting knowledge to students who repeat and memorize what they learn (Demirel, 2010; Şimşek, 2022). In the constructivist learning model, learning occurs through the transfer of existing knowledge and reconstruction of it (Demirel, 2010). In this regard, practices that put the student into the center are based on the basic principles of constructivist theory (Dal & Tatar, 2017; Saracaloğlu, 2019). The process of acquiring knowledge and experiences as a result of communication with the environment and accommodation of them in a proper manner supports the creation of knowledge (Akyol, 2006). Constructivist learning approaches put students into the center, enable them to use their potential and organize knowledge, allow them to work in cooperation with their peers in the same classroom, and use their experiences while forming knowledge (Titiz, 2005). There are many learning models based on the constructivist learning approach. As a result of the literature review, when the studies on constructivist learning models are examined, it is seen that there are many meta-analysis studies on cooperative, problem-based, project-based and inquiry-based learning models (Akuma & Callaghan, 2019; Arık & Yılmaz, 2020; Ayaz & Şekerci, 2016; Azer & Azer, 2015; Bores-Garcia et al. 2021; Erişen & Günay, 2015; Hall & Quinn, 2014; Jamal et al., 2019; Musna et al., 2021; Semerci & Batdı, 2015; Suparman et al., 2021; Zakaria et al., 2019). Therefore, these models were emphasized in the study.

There is student-student interaction besides teacher-student interaction in learning environments in classrooms. The level of this interaction might have positive and negative impacts on learning levels, student attitudes towards school and teacher, their thoughts about one another, and their self-esteem (Ekinci, 2011). Cooperative learning takes learning resulting from the interaction among students into consideration.

In this learning model, students learn and support a specific topic in small groups; they help one another and work together (Gökalp, 2019). Cooperative learning includes many attractive features such as establishing new friendships, discovering one another, observing the similarities between friends in the process of learning. Teachers prefer using the cooperative learning model in learning and teaching processes for many reasons, such as increasing success, developing high-level thinking skills, improving self-esteem, supporting positive attitudes towards school and classes, and ensuring socialization (Ekinci, 2011).

Problem-based learning is used in different disciplines in the education process (Zakaria et al., 2019). This learning model presents real-life problems to students, enables them to learn in the scope of these problems, increases their active participation, enables them to make sense of information, and makes learning permanent. In this model, learning occurs as a result of the effort to understand a problem and finding a solution to it (Erdem-Gürlen, 2011). Students produce solutions by using the existing information in the frame of the problem presented by the teacher and they support each other's learning in line with a specific target (Kaptan & Korkmaz, 2001). When students can reflect on their previous knowledge and experiences in the process of problem-solving, it positively affects the problem-solving process and learning environment (Akın, 2009). In a learning process based on problem-based learning: Existing knowledge becomes observable, learning is supported by presenting problems that can occur in real-life, the acquired information is organized, and knowledge becomes permanent (Erdem-Gürlen, 2011).

The project-based learning model enables students to establish inter-disciplinary connections and accordingly create a more supportive education environment; it defends integration with the real-world while acquiring information (Genç, 2017). The purpose of this model, which is based on the creation of a product by students in a cooperative environment, is to support students have personal responsibilities, motivate them about being creative as part of a group, improve their problem-solving skills, design and create their products and think like scientists (Gökalp, 2019).

Inquiry-based learning model is an approach that enables students to actively participate in the education process, improve their ability to use scientific processes, and support their thinking skills by making discussions and activities (Duran & Dökme, 2018). In a research-based learning strategy, the student bears the role of an individual that research, question, explain and make suggestions about the information he/she should learn (Sarı & Şaşmaz-Ören, 2020). In inquiry-based learning, educators aim to enable students to analyze a topic in detail and give the effort to find a solution. Students actively participate in the process by asking questions, making research and observations, and taking responsibility (Davis, 2005).

Method

The second-order meta-analysis method is preferred in the study in line with the purpose. Second-order meta-analysis is the meta-analysis of first-order meta-analysis. Meta-analysis research is used in the second-order meta-analysis method instead of basic research (Oh, 2020). In the second-order meta-analysis method, statistical data of the meta-analysis research are synthesized, similar to the first-order meta-analysis method (Schmidt & Oh, 2013). It is possible to make more general and comprehensive

analyses in this method. The second-order meta-analysis method allows combining and evaluating more than one meta-analysis research. As the purpose of this study is to generally evaluate the effects of constructivist learning models on student outcomes, second-order meta-analysis is preferred.

Data Collection

Web of Science, Scopus, ERIC, and TR Index databases are used to collect the data for this study. TR Index is a database including Turkish scientific published articles. The option of "title" is used while doing searches in databases. Searches are carried out both in Turkish and English. Keywords presented in Table 1 are used in searching titles.

Table 1

Keyword Pool and Abbreviations

Group	Keyword pool		Abbreviations	
for learning models	for English	for Turkish	Constructivist Learning Model	CLM
	Problem-based	Probleme dayalı	Problem Based Learning	PBL
	Project-based	Proje temelli	Project Based Learning	PjBL
	Cooperative Learning, Collaborative learning, Laboratory-Based, Group learning, team learning	İşbirlikli, işbirlikçi, laboratuvar temelli, grupla öğrenme, takımla öğrenme	Cooperative Learning	CL
	Inquiry, learning cycle (3E,5E,7E)	Sorgulamaya dayalı, araştırmaya dayalı, öğrenme halkaları (3E,5E,7E)	Inquiry Based Learning	IBL
	Case-based learning	Örnek olaya dayalı	Case Based Learning	CBL
	Argumentation-Based Learning	Argumantasyona dayalı		ABL
	Constructivist	Yapılandırmacı, oluşturmacı		
for method	Meta-analysis, meta-analytic, systematic review	Meta analiz, meta analitik, sistematik inceleme		

Search results are evaluated according to the inclusion and exclusion criteria that were determined before. These criteria are taken into consideration while choosing research.

Inclusion and Exclusion Criteria

1. Meta-analysis research should focus on only one constructivist-learning model, such as PBL, CL, PjBL, or IBL. If constructivist learning models are defined and analyzed independently from one another (e.g., if moderator variable is assigned), they are included in this study. However, if the types of constructivist learning models are not clearly defined, they are excluded. Besides, meta-analysis studies that involve constructivist learning models supported with technological tools (e. g computer-based, technologies supporting, inquiry-

based mobile learning, and digital problem-based learning) are excluded. In other words, blended constructivist learning models are excluded.

2. Meta-analysis research should include basic research at the K-12 level. It is excluded if research includes basic research at the higher education level. If the analysis is carried out along with higher education level and impact size according to level (primary, middle, high, and tertiary) is reported, these meta-analysis studies are excluded.
3. Meta-analysis research should focus on student outcomes.
4. Meta-analysis research sample group should be general students. Meta-analysis research that involves gifted and high-achieving students is excluded.
5. Meta-analysis research should have been published between 2015 and 2021. Current years are preferred to decrease the problem of overlap among meta-analysis researchers.
6. The language of meta-analysis research should be either English or Turkish. As researchers of this study know English and Turkish languages, meta-analysis studies are limited to these languages.
7. Basic research that are the basis of meta-analysis research should have an experimental design. Learning models should be tools of intervention. Analyzed learning models should be well-defined. Researchers whose learning models are not certain are excluded.
8. If meta-analysis studies have more than a 25% overlapping ratio, if they are current and comprehensive, they are included in this study. Cooper and Koenka (2012) state that if overlapping ratios are below 25% these meta-analysis studies are independent of one another. Meta-analysis research that have more than a 25% overlapping ratio are presented in Table 2. On the other hand, meta-analysis research that are preferred and excluded are presented in the same table. Meta-analysis research that are current and comprehensive are preferred after determining that they are overlapping.

Table 2

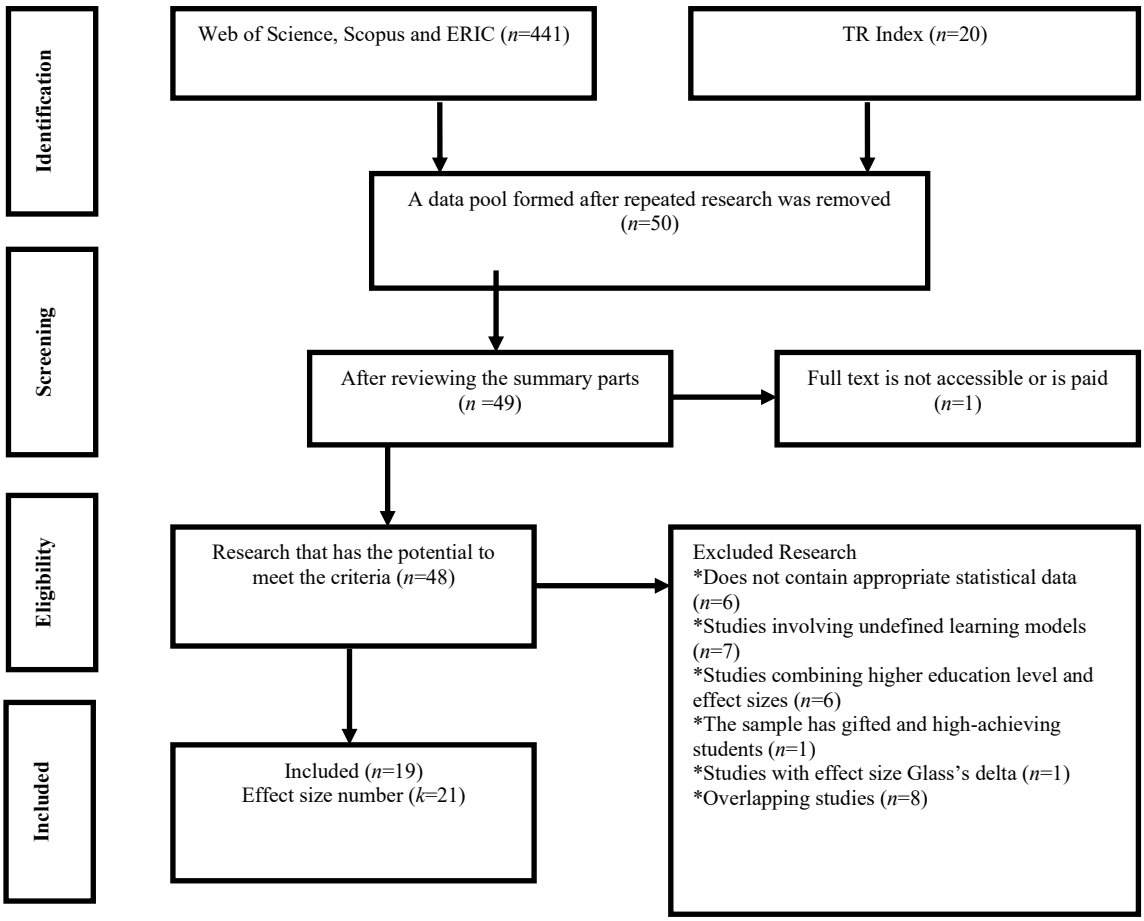
Research That Are Included and Excluded because of Overlap

Excluded	Included	Model	Outcome
Juandi & Tamur (2021)	Suparman et al. (2021)	PBL	thinking skill
	Yohannes, et al. (2020)		
	Musna et al. (2021)		
Ayaz (2015)	Demirel & Dağyar (2016)	PBL	Attitude
Capar & Tarım (2015)	Turgut & Gülşen-Turgut (2018)	CL	Achievement
Aktamış et al. (2016)	Sarı & Şaşmaz-Ören (2020)	IBL	Achievement
Aktamış et al. (2016)	Şaşmaz-Ören & Sarı (2019)	IBL	Thinking skill
Balta & Sarac (2016)	Sarac (2018)	IBL	Achievement
Yaman & Karaşah (2018)			
Balemen & Özer-Keskin (2018)	Ayaz & Söylemez (2015)	PjBL	Achievement

9. Meta-analysis research should include sufficient statistical index to calculate generic effect size (e.g., Cohen's d, Hedge's g, and lower limit based on these impact sizes (*LL*), the upper limit (*UL*), Standard error (*SE*), variance value. Glass's delta value is used when the standard deviation value between the experiment and control group is meaningfully different. The control group's standard deviation value is used to calculate Glass's delta value (Henson, 2006). This is why Glass's impact size calculation method for determining the standardized mean difference yield relatively different results from Hedge (*g*) and Cohen's (*d*) impact size calculation method. On the other hand, Hedge' *g* and Cohen's *d* yield approximately similar impact size values. This is why; meta-analysis research that involves Glass's delta impact size is excluded. Studies produced by the database according to CLM types are presented in Appendix 1. A general data flow diagram about the choice of data in the scope of this study is presented in Figure 1.

Figure 1

General Dataflow Diagram



CBL and ABL model meta-analysis research in CLM presented in Table 1 could not be accessed. This is why; the study includes 19 meta-analysis types of research of PBL, PjBL, CL, and IBL learning models. Meta-analysis research features of the dataset of this study are presented in Appendix 1. Meta-analysis research is coded after research.

Coding

CLM: PBL, PjBL, CL, and IBL are coded as constructivist learning models. If a meta-analysis study involves more than one CLM, they are coded independently (Codes: PBL, PjBL, CL, and IBL).

Student outcomes: Student outcomes are coded as academic success, thinking skills and attitude, problem-solving skills, higher-order thinking skills, and critical thinking skills.

Education level: If meta-analysis research comprises many education levels, K-12 level impact size is coded. This type of meta-analysis research is coded as mixed. If research only includes secondary or middle, it is coded as the same (Codes: mixed, middle, secondary).

Location: If meta-analysis research is made of studies originating from more than one country, it is coded as mixed. If it only represents one country, it is coded as the same (Codes: mixed, Turkey, Indonesia, China).

Primary research report type: If meta-analysis research includes at least two of the options of article, declaration, or master's thesis, it is coded as mixed; if they include one, they are coded as the same (Codes: mixed, article).

Academic field: If meta-analysis research includes at least two of the options of math, science, and other fields, they are coded as mixed; if they include only one, they are coded as the same. On the other hand, if the different field of the academic field group is k<3, it is coded as other fields (Codes: mixed, math, other).

Publication bias: If publication bias is detected, it is coded as yes. If not, it is coded as no, and if there is no information about the publication bias, it is coded as NA (Codes: yes, no, NA).

Quality level: Meta-analysis research is coded according to the scores obtained from the quality scale (Codes: Insufficient, low, medium, high).

Quality Evaluation

Revised Assessment of Multiple Systematic Reviews (R-AMSTAR), revised by Kung et al. (2010), is used to evaluate the quality of meta-analysis studies. While the R-AMSTAR scale is being evaluated: 0 to 11 = insufficient, 12 to 22 = low, 23 to 33 = medium, and 34 to 44 = high (Young, 2017). R-AMSTAR scale's 8C and 8D articles are developed for clinical practice. These articles are used in this study, and 8A and 8B articles are coded as 2 points while scoring the scale.

Data Analysis

The analysis unit of this study is at the level of research. Each meta-analysis research represents independent impact size. The use of the random effect model is suggested if research is based on different sampling and features of research vary from one another (Borenstein et al., 2011). The mean impact size, heterogeneity analysis, and moderator analysis processes of this study are carried out under a random effect model. Meta-analytic statistical analyses are carried out under CMA.2 program.

Impact Size: Cohen's impact size calculation method and (*Cohen's d*) Hedge's calculation method (*Hedge's g*) yield approximately the same results in big samplings (Marfo & Okyere, 2019; Turner & Bernard, 2006). However, Cohen's impact size

calculation method yields subjective impact size in small samplings (Turner & Bernard, 2006). Hedge, on the other hand, developed a different calculation method to correct this subjective value. Hedge's impact size calculation method is the corrected version of Cohen's d (Goulet-Pelletier, & Cousineau, 2018; Marfo & Okyere, 2019). When the above-mentioned explanations are taken into consideration, it can be said that the impact size of meta-analysis research included in the dataset of this study is coded according to how they are reported. It is accepted that the difference between *Hedge's g* and *Cohen's d* values is quite small. On the other hand, it is accepted that most of the research included in meta-analysis research has a large sample. Tamim et al. (2011) and Young (2017) used a similar coding process and acceptances in their second-order meta-analysis study in which they analyzed the technology-supported education's effects on learning outcomes. Similarly, Hew et al. (2021) used coding and acceptances in their second-order meta-analysis study focusing on analyzing flipped classroom practice's effects in different disciplines. This study uses *Hedge's g* impact size in line with this information.

Impact size calculation at K-12 level: Meta-analysis research included in this study is generally made of research that involves higher education level (n=13). In other words, meta-analysis research report impact sizes according to education levels as primary, middle, high, and tertiary. These types of research are combined under a random model for impact size at the K-12 level. There are two reasons why this combination is made. Firstly, education levels included in meta-analysis research are not coherent. For instance, primary (K1-K4) and middle (K5-K8) levels are coded independently, while some research is coded together. On the other hand, the basic number of research included in some education levels in meta-analysis research is quite low (k<5). In other words, the sampling number is quite low on some levels. Small sampling group is also a resource of bias (Lin, 2018). Impact sizes of independent education levels meta-analysis research are combined by considering this information.

Publication bias analysis: Egger's test and Duval & Tweedie's trim and fill analysis techniques are used in publication bias analyses of the dataset (Jin et al., 2015).

Heterogeneity and moderator analysis: Q statistics are used to determine the heterogeneity level of the dataset. Besides, I^2 is calculated to determine the heterogeneity level of the dataset and related value is interpreted. Reflective moderator variables that reflect the features of meta-analysis research are defined. *Q* between tests is conducted to see if the mean impact size varied according to moderator variables. On the other hand, mean impact size is calculated and interpreted according to moderator variables.

Ethical Procedures

A meta-analysis is an analysis that includes evaluations made using research results obtained in previous studies. In this regard, it does not require the approval of the ethics committee.

Results

This section of this study presents descriptive statistics of the dataset, mean impact size, publication bias analysis, heterogeneity, and moderator analyses.

Descriptive Statistics and Mean Impact Size

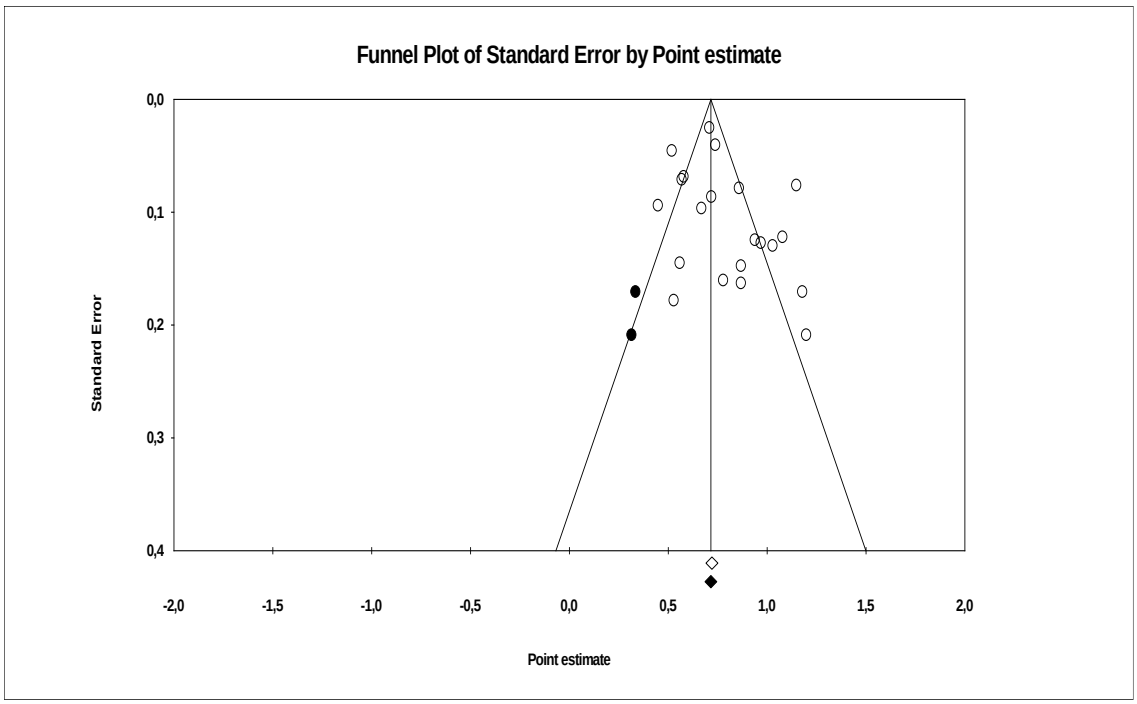
The dataset is made of n=19 independent meta-analysis research. Meta-analysis research consists of a total of 623 independent basic research. k=21 impact size is obtained from the meta-analysis research constituting the dataset. Impact sizes vary between ES=.45 and ES=1.20. The mean impact size is ES=.78 LL=.70 UL=.87. The total heterogeneity amount of the dataset is $Q(20)$ =109.18 (p<.001). The heterogeneity level of the dataset is I^2=81.68.

Publication Bias Analysis

It was determined that there is no publication bias according to Egger's regression test (t=1, 67 p=.11) result. On the other hand, it was found that there is no publication bias according to Duval & Tweedie trim and fill analysis (DTtf) result. According to the DTtf test result, two meta-analyses research should be added to the left side of the mean impact size. According to the DTtf test result, the corrected/adjusted impact size value is calculated to be ES=.76 LL=.68 UL=.84. The difference between the observed value and the corrected value is approximately .02. It can be said that this difference is not important. In addition, the graphic of the distribution of impact size according to standard errors is analyzed. The funnel plot graphic is presented in Figure 2. It can be said that the Funnel plot graphic is approximately symmetrical. When the above-mentioned publication bias analysis results are evaluated together, it can be said that there is an unimportantly low publication bias.

Figure 2

Funnel Pilot Graphic (The Number of Research on Which Dark Spots Should Be Added k=2)



Moderator and Heterogeneity Analyses

Moderator and heterogeneity analyses of the dataset are presented in Table 4. Groups with impact size numbers below k< 3 are not interpreted.

Table 4

Moderator and Heterogeneity Analyses of the Dataset

Group	*k*	*ES (g)*	*LL*	*UL*	*Q*	*df (Q)*	*p*
Outcomes					6.32	2	.04
Achievement	14	.81	.71	.91			
Attitude	3	.51	.27	.74			
Thinking skill	4	.88	.66	1.09			
CLM					1.28	3	.73
PBL	7	.86	.67	1.05			
PjBL	2	.87	.56	1.18			
CL	5	.73	.53	.94			
IBL	7	.75	.58	.92			
Domain					.17	2	.92
Math	7	.76	.60	.91			
Mixed	11	.80	.68	.91			
Other	3	.80	.57	1.03			
Location					15.55	3	<.01
Mixed	5	.67	.53	.81			
Turkey	10	.87	.76	.97			
China	3	.58	.42	.75			
Indonesia	3	1.07	.82	1.32			
Bias					4.55	2	.10
NA	1	.86	.53	1.19			
No	12	.71	.60	.81			
Yes	8	.89	.76	1.02			
Quality					.83	1	.36
High	7	.73	.59	.88			
Medium	14	.82	.71	.92			
Report Type					2.44	1	.12
Article	5	.93	.73	1.12			
Mixed	16	.75	.65	.85			
Level					3.46	2	.18
Mixed	18	.80	.71	.89			
Secondary	2	.82	.49	1.14			
Middle	1	.45	.09	.81			

Important findings in Table 4 are presented below. CLM's impact statistically varies according to student outcome types ($Q_b(2) = 6.32$, p=.04). While CLM has a high impact on students' thinking skills and academics (*ES*=.88, *ES*=.81 respectively), its impact on student attitudes is (*ES*=.51) medium-level. Similarly, CLM's impact on student outcomes according to the location included in the meta-analysis research statistically varies ($Q_b(3)$=15.55 p<.01). A mixed-type meta-analysis, including research from different countries, had a lower or medium-level effect (*ES*=.67). Similarly, meta-analysis research, including China sampling, produced medium-level impact size (*ES*=.58). On the other hand, meta-analysis research, including Turkey and Indonesia sampling, produced high-level impact (*ES*=.87; *ES*=1.07, respectively).

Discussion and Conclusion

The effects of constructivist learning models on student outcomes are analyzed in this research. For this purpose, findings of 19 different meta-analysis research results obtained from a variety of databases are synthesized with the second-order meta-analysis method. At the end of the research process, it is determined that constructivist-learning models' effects on student outcomes are medium level. When the related literature is analyzed (Akuma & Callaghan, 2019; Ayaz & Şekerci, 2016; Azer & Azer, 2015; Bores-Garcia et al., 2021; Hall & Quinn, 2014; Jamal et al., 2019; Musna et al., 2021; Şaşmaz-Ören & Sarı, 2019; Semerci & Batdı, 2015; Suparman et al., 2021; Zakaria et al., 2019), it is seen that findings are in parallel with the results of this study. Based on this information, it can be said that constructivist-learning models have a positive impact on student outcomes.

On the other hand, application of constructivist learning models is a process that requires professionalism (Kaya, 2013). Teachers and school managers need to gain knowledge and skills about constructivist learning models. In this context, in-service training programs that introduce constructivist-learning models can be organized in different education regions. Similarly, atelier studies can be organized to support teachers' knowledge and experience in practicing constructivist-learning models.

According to the results of moderator analysis, carried out according to the location of meta-analysis research, constructivist learning models' effects on student outcomes vary. If meta-analysis studies used in the research involve more than one country, they produce bigger impact sizes. On the other hand, impact size according to counties is quite different. For instance, meta-analysis research involving China produced medium-level impact size, while meta-analysis research involving Turkey and Indonesia produced high-level impact size. School systems that produce high impact size might be the countries in which traditional education methods are dominant. Turkey's education system is dominated by traditional methods (Kayabaşı, 2012; Terzi, 2011). Constructivist learning models are more flexible and put students at the center when compared to traditional learning models. This flexibility might be the reason some countries produced higher impact sizes. Location bias is a problem in meta-analysis research. According to Higgins and Green (2011), there are two forms of location bias. The first form is based on the database with research, while the second is the country from which research is collected. Vickers et al. (1998) state that impact sizes in clinical applications statistically vary; this situation about clinical applications might also be true for school applications.

To cope with location bias, meta-analysis research can be carried out in a way that includes different counties and different databases. On the other hand, country-based first-order meta-analyses can be combined with the second-order meta-analysis method. Cultural dimensions of countries can be examined as potential moderators in these combination processes. Besides, research that analyzes learning models in cultural contexts can be included.

Implications

This study is limited to the meta-analysis research carried out between 2015 and 2021 in English and Turkish languages. Suggestions for more comprehensive analyses are presented below. The effects of constructivist learning models on student outcomes in different learning models can be analyzed separately.

This study is limited to constructivist learning models: Problem-based, inquiry-based, project-based, and cooperative. Future studies can be carried out in a way that they include case-based, argumentation-based learning, and other learning models. This study excluded blended constructive learning models. Future studies can focus on the effects of constructive learning models blended with education technologies and other elements on student outcomes.

When the related literature is analyzed, it can be seen that most researchers focus on academic success. This study includes meta-analysis research about academic success in line with this finding. Future studies can focus on the effects of constructivist learning models on students' thinking skills (creative, critical, reflective, meta-cognitive, and others). When the related studies in the literature are analyzed, it is seen that meta-analysis research focuses on student attitudes more than their effective features. Meta-analysis research focusing on self-regulation, self-sufficiency, and other affective features can be carried out in the future, contributing to the literature.

Statement of Responsibility

The study was conducted and reported with equal collaboration of the researchers. The researchers had equal roles in the tasks for conceptualization, resources, data collection and analysis, reporting, drafting, reviewing and editing.

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Appendix 1. Studies included in the second order meta-analysis

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