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The Effect of Multiple Intelligence Theory-based Science Teaching on Academic Success in Turkey: A Meta-Analysis Study[1]

Türkiye'deki Çoklu Zekâ Kuramına Dayalı Fen Öğretiminin Akademik Başarıya Etkisi: Bir Meta-Analiz Çalışması

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ABSTRACT

The aim of present study is to calculate the overall effect size of the learning based on Multiple Intelligences Theory, which was conducted in Turkey between 2006-2019, on the science academic achievement of students compared to the learning method envisaged in the program, using the meta-analysis method. In addition, when the multiple intelligence theory was examined in terms of science course sub-titles (Science Field: Physics-Chemistry-Biology), the differences between effect sizes in terms of academic achievement were examined. For this purpose, related studies were examined in the subject area and 44 studies were included in the meta-analysis for academic success that met the criteria. Data analysis in the research was conducted through the CMA program. When the meta-analysis results in this study were evaluated, the effect size of learning based on multiple intelligence theory on students' academic success was calculated as 1,024. The effect size obtained is described as "large level" according to Cohen (1988) and Thalheimer and Cook (2002) classifications. As a result, it was seen that the learning method based on the theory of multiple intelligences had a significant effect on the academic success in the science lesson compared to the teaching method predicted in the program. In the moderator's review, it was concluded that there was no significant difference between the effect sizes of learning based on multiple intelligence theory in terms of science fields on academic success. According to the result obtained from the study, multiple intelligences theory-based learning positively affects students' academic success in the lesson.

Keywords: *Meta-Analysis, Multiple intelligence theory, science teaching*

[1] This study was produced from Ebru KURAL's masters' thesis under the supervision of Murat OKUR.

ÖZ

Bu çalışmanın amacı, 2006-2019 yılları arasında Türkiye de yapılan Çoklu Zekâ Kuramı'na dayalı öğrenmenin programda ön görülen öğrenme yöntemine kıyasla öğrencilerin fen akademik başarısına etkisini meta analiz yöntemiyle genel etki büyüklüğünü hesaplamaktır. Ayrıca, çoklu zekâ kuramının fen bilimleri dersi alt başlıkları (Fen Alanı: Fizik-Kimya-Biyoloji) açısından incelendiğinde akademik başarı açısından etki büyüklükleri arasında farklılıklara bakılmıştır. Bu amaçla, konu alanında yapılmış olan çalışmalar incelenerek belirlenen ölçütleri karşılayan akademik başarı için 44 çalışma meta analize dâhil edilmiştir. Araştırmada analizler, CMA programı yardı ile yapılmıştır. Bu çalışmadaki meta analiz sonuçları değerlendirildiğinde çoklu zekâ kuramına dayalı öğrenmenin öğrencilerin akademik başarıları üzerindeki etki büyüklüğü 1,024 olarak hesaplanmıştır. Elde edilen etki büyüklüğü Cohen (1988) ve Thalheimer ve Cook (2002) sınıflamalarına göre etki büyüklüğü "geniş düzey" olarak açıklanmaktadır. Sonuç olarak çoklu zekâ kuramına dayalı öğrenme yöntemi, programda ön görülen öğretim yöntemine göre fen dersindeki akademik başarı üzerinde anlamlı bir etkiye sahip olduğu görüldü. Moderatör incelemesinde fen alanları açısından çoklu zekâ kuramına dayalı öğrenmenin akademik başarıdaki etki büyüklükleri arasında anlamlı bir farklılık göstermediği sonucu elde edilmiştir. Çalışmadan elde edilen sonuca göre çoklu zekâ kuramına dayalı öğrenme, öğrencilerin dersteki akademik başarılarına olumlu yönde etki etmektedir.

***Anahtar Kelimeler**: Çoklu zekâ kuramı, fen öğretimi, meta-analiz*

INTRODUCTION

In the science course curriculum, it is expected that the lessons will be conducted in student-centered learning environments and opportunities will be presented that enable students to develop creative thinking skills by expressing themselves visually, verbally and in writing during the learning process (Ministry of National Education [MoNE], 2018). Especially in subjects involving abstract concepts, science lessons should be applied in a way that will attract students' attention, develop their thinking skills and enable learning (Novak & Gowin, 1984). The student-centered theory of multiple intelligences plays an important role in achieving the goals of the science lesson (Goodnough, 2001).

Multiple Intelligence Theory argues that individuals have different intelligence domains at different degrees, individuals with different characteristics cannot learn in the same way, that each individual is different, and that these individual differences in individuals should be revealed and education should be given according to these differences (Gardner, 1983).

In his 1983 book "Frames of Mind", Gardner argued that there are at least seven basic intelligence areas in an individual. However, Gardner stated that these types of intelligence are not sufficient in expressing the multiplicity of the individual's abilities and that there may always be more areas, and in this direction, he mentioned the existence of an eighth intelligence domain in 1997 and revised multiple intelligences as 8 domains in his book "Intelligence Reframed" published in 1999 (Işık, 2006). The eight types of intelligence domains put forward by Gardner are: Verbal-Linguistic Intelligence, Mathematical-Logical Intelligence, Visual-Spatial Intelligence, Musical-Rhythmic Intelligence, Bodily-Kinesthetic Intelligence, Social-Interpersonal Intelligence Internal and Natural Intelligence

Gardner argued that there was no disconnection between the intelligence domains, but a tight bond (Sönmez, 2008). Along with the Multiple Intelligence Theory, which defines eight separate intelligences, reveals the view that weak intelligences can be strengthened with different methods to be applied, but it also contributes to the academic success of the students, the permanence of the learned subjects and the development of a positive attitude towards the lesson (Selçuk, Kayılı & Okut, 2002). Individuals' different intelligence domains play an important role in learning the subject in a lesson (Gardner & Hatch, 1989). Activities organized in learning environments prepared in accordance with the multiple intelligences theory enable students to participate in the lesson more effectively and to achieve permanent learning (Goodnough, 2001).

Independent and different studies that investigate the effect of the multiple intelligence theory- based teaching on academic success in science subjects in our country (Altun, 2006; Akman, 2007; Öngören & Şahin,

2008; Değirmenci, 2009; Korkmaz, 2010; Kurt, et al, 2011 ; Erkaçan, et al, 2012; Şakir, 2013; Öztürk, 2014; Tüysüz, 2015; Şenel, 2016; Şahan, 2018) available in the literature. However, studies that bring together the results of these studies as numerical data and reveal the effect of teaching based on multiple intelligence theory in science subjects on the academic achievement of students are limited (Yurt & Polat, 2015; Aydın, 2019; Çetinkıl, et al., 2017). In this study, unlike the studies conducted, the difference between the effect sizes in terms of academic achievement was examined by examining the multiple intelligence theory in terms of science sub-titles between the years 2006-2019. In present study, it is aimed to combine studies that reveal the effect of multiple intelligence-based teaching on students' academic success in science subjects with experimental research models with meta-analysis method.

Purpose of the research

The aim of this study is to examine the studies between the years 2006-2019, in which the multiple intelligence theory activities used in science education were carried out, with the meta-analysis method, and to determine the difference between the effect sizes on academic achievement in terms of the general effect of students on science academic success and sub-fields of science. In the present study, experimental and quasi-experimental studies that examine the effectiveness of multiple intelligence theory in terms of academic success will be brought together. Whether the theory of multiple intelligence has an effect and the size of its effect will be sought. In addition, present study aims to bring a general perspective to the studies conducted in our country, to shed light on the new studies to be carried out and to help generate ideas about the inclusion of multiple intelligence theory applications in the curriculum. The sub-problem on the subject is given below.

1. Does the theory of multiple intelligences used in science education have a positive effect on students' academic success?
2. When the multiple intelligences theory is examined in terms of science course sub-titles (Science: Physics-Chemistry-Biology), is there a difference between effect sizes in terms of academic achievement?

METHOD

Research Model

In present study, meta-analysis method was used to calculate the effect size of science teaching based on multiple intelligence theory on academic success. Meta analysis is a statistical method that aims to bring together studies conducted by different researchers at different times and places on a specific subject using appropriate statistical methods (Fraenkel & Wallen, 2009; Hedges & Olkin, 1985; Whitehead, 2002). Briefly, meta-analysis is the analysis of analysis (Glass, 1976).

Data Collection

In this study, all published and unpublished thesis studies, articles obtained from national and international databases published in electronic environment, articles published in national journals were used as data sources and those suitable for analysis were included in the study. While collecting data in the study, the National Thesis Center of the Council of Higher Education to reach the thesis, to reach scientific articles ULAKBİM database and the Google Scholar internet search engine "multiple intelligences", "multiple intelligences and learning", "multiple intelligences and success", "Multiple Intelligence Theory" key words have been searched. Studies were filtered as those in the field of science and those containing the academic success variable, and as a result, 47 studies were obtained to examine the effect of multiple intelligence teaching on academic success. According to Lipsey and Wilson (2001), in order for a study to be included in meta-analysis, it must have the necessary data for analysis and must be within the boundaries of the research. Based on this, the following criteria were taken into account when determining the studies included in the study.

The Criteria Required for Studies to Be Included Within the Scope of the Research

- Studies should have been conducted within the last 13 years (2006-2019).
- Studies must be accessible from Council of Higher Education (CHE) Thesis, published/unpublished theses, periodical or online academic journals, databases.
- In order to measure the standardized effect size in meta-analysis studies, the studies included in the study should have control and experimental groups and use the teaching method proposed in the program for the control group and multiple intelligence applications to the experimental group.
- In order to determine the effect size of meta-analysis studies, studies in which sample size, mean value and standard deviation value of the experimental and control groups of the studies included in the study are known, are included.
- Since the studies to be used in the research should be used in science lessons, attention has been paid to the fact that studies have been carried out between 4th grade – 11th grade and pre-service teachers.
- The researches to be included in the study should measure the effect of the lessons taught with the theory of multiple intelligences on academic success with quantitative data.
- Studies conducted in Turkey and in the Turkish language are among the criteria for inclusion.

When the studies obtained as a result of the searches were examined, firstly, thesis studies were preferred and coded to be included in the analysis. Since some of the studies were not experimental studies, some could not be included in the analysis because they did not contain enough data to analyze (Yağcı, 2006; Oral, 2008; Diken &Aydoğdu, 2018). As a result, the sample of the meta-analysis study, which deals with the effect of Multiple Intelligence Theory on academic success, consists of 44 studies.

Data Coding

The data obtained according to the criteria determined in the research were recorded using the prepared coding form. After the relevant studies are collected in meta-analysis studies, a coding system should be developed that will transform the criteria of the research into continuous or categorical variables so that studies that meet the inclusion criteria can be used in comparisons between meta-analysis studies in the next stages (Okursoy Günhan, 2009). With the help of the developed coding form, the researcher will be able to reach the desired information in a shorter time and easily. Although the coding form has general features to cover all studies, it should be capable of distinguishing studies from each other (Özdemirli, 2011). The coding form developed for the meta-analysis study consists of three main parts. In the first part, the name of the study, the year of study, the author or authors of the study and the sample size are included. In the second part, there are general questions to get information about the general features of the study. In the third part, there are statistical data of the study. The study form developed to be used in the study was created by the researcher by re-developing the coding forms used by Camnalbur (2008), Günhan (2009), Armağan (2011), and Gözübebek (2012). The created form is still ready for use after being examined by instructors who are experts in their fields.

Data Analysis

In this study, CMA 2.0 statistical program was used to calculate effect sizes and to obtain graphics, "Hedges's g" was used in calculating effect size, and Microsoft Office Excel 2010 programs were used in collecting and processing data. The significance level was chosen as "0.005" for the statistical analysis in the study. After the classifications were made according to the study statistics, the analysis effect sizes were calculated using the Fixed Effect Size and the Random Effect Size.

Effect size is the basic unit of meta-analysis studies and is a value that represents the relationship between two variables or the size of the application effect (Dinçer, 2014). The main purpose of meta-analysis is to cal-

culate an average effect size value by combining relevant data and try to determine homogeneity. The values related to the effect size can be interpreted by comparing them with some criterion values. These are as follows;

Effect size values based on arithmetic means according to Cohen (1988);

- Between 0.20 and 0.50, it has a small level effect.
- Between 0.50 and 0.80, it has a medium level effect.
- If it is bigger than 0.80, it has a large level effect.

According to Shachar (2002: as cited in Camnalbur, 2008);

- If the effect size value is $0 \leq$ and ≤ 0.32, it has a small level effect.
- If the effect size value is $0.33 \leq$ and ≤ 0.55, it has a medium level effect.
- If the effect size value is $0.56 \leq$, it has a large level effect.

More detailed classification (Thalheimer & Cook, 2002);

- $-0.15 \leq$ Effect size value <0.15 negligible,
- $0.15 \leq$ Effect size value <0.40 small,
- $0.40 \leq$ Effect size value <0.75 medium,
- $0.75 \leq$ Effect size value <1.10 large,
- $1.10 \leq$ Effect size value <1.45 very large,
- $1.45 \leq$ The effect size value has an enormous effect.

FINDINGS

In this section, the findings obtained as a result of the analysis of the studies that comply with the meta-analysis criteria are included.

The main purpose of the meta-analysis study carried out is to calculate the effect size of the multiple intelligences theory-based learning on students' academic success. In addition, the study includes the findings of the science sub-branches moderator. In line with this aim, literature was reviwed and studies with appropriate criteria were collected and analyzed. As a result, the difference between the effect sizes of the learning based on the theory of multiple intelligences in terms of academic success according to the method proposed in the program has been explained.

Descriptive Data of Studies

The sample number in all 44 individual studies of the academic success variable to be included in the meta-analysis study was 1489 students in the experimental group and 1266 students in the control group**.** The frequency/percentage statistics of the studies included in the meta-analysis study, according to the type of publication, according to the years of the study and according to the science field of the study, are as follows.

Table 1. Distribution of the Study by Publication Type

Broadcast Type	Frequency (f)	Percent (%)
PhD	3	6,82
Master's Theses	36	81,82
Article	5	11,36
TOTAL	44	100

When the distribution of the studies included in the meta-analysis study according to the type of publication is examined; It is seen that theses (88.64%) are predominant in studies examining the academic achievement variable. When the theses are examined, it is seen that the most data is obtained from the master's theses. Master's theses constitute 81.82% of the study.

Table 2. Distribution of Studies by Science Field

Science Field	Frequency (f)	Percent (%)
Physical	6	13,63
Chemical	2	4,55
Biology	12	27,27
Science	24	54,54
TOTAL	44	100

When the distribution of the studies included in the meta-analysis study according to the field of science is examined; In studies examining the academic achievement variable, it is seen that studies on science (54.55%) are predominant.

Findings about the Effect Sizes of Studies Related to Academic Success

The findings of the meta-analysis study conducted to compare the effect of the multiple intelligence theory-based learning on the academic success of students in science lesson and the effect of the teaching method prescribed in the program on the academic success of students in science lessons are explained below.

Overall Effect Size Findings Regarding Academic Success

Belonging to the problem of the research "Does the multiple intelligence theory used in science education have a positive effect on students' academic success?", the group mean, standard deviation and sample size data, individual effect size and overall effect size from 44 studies were analyzed with the CMA 2.0 program. Cohen (1988) classification and Thalheimer and Cook (2002) classification were used to interpret the data. The individual effect sizes, p values, sub and upper limits of the 44 studies included in the meta-analysis study are given in Table 3 below.

Table 3. Effect Sizes and Study Data of Academic Achievement Studies Used in Meta-Analysis Study

Study Code	Effect Size	Standard Error	Variance	Sub Limit	Upper Limit	P
Sahan, 2018	2,773	0,462	0,213	1,869	3,678	0,000
Ozturk, 2014	0,443	0,206	0,043	0,038	0,847	0,032
Beyazit, 2009	0,655	0,271	0,073	0,125	1,186	0,015
Sengul, 2007	1,192	0,297	0,088	0,610	1,775	0,000
Ongoren, 2007	0,581	0,260	0,068	0,071	1,091	0,026
Gokcek, 2007	0,365	0,257	0,066	-0,138	0,869	0,155
Turhan, 2006	0,994	0,337	0,114	0,332	1,655	0,003
Kara, 2006	0,289	0,256	0,066	-0,213	0,791	0,259
Isik, 2006	0,653	0,275	0,076	0,113	1,193	0,018
Gazioglu, 2006	0,760	0,321	0,103	0,130	1,389	0,018
Dilek, 2006	0,644	0,262	0,068	0,132	1,157	0,014
Ayaz, 2006	0,447	0,282	0,080	-0,106	0,999	0,113
Altun, 2006	1,396	0,285	0,081	0,838	1,955	0,000
Gunes, 2006	0,649	0,314	0,099	0,033	1,264	0,039
Degirmenci, 2009	1,755	0,329	0,108	1,110	2,400	0,000

Inaltekin, 2008	0,473	0,250	0,063	-0,018	0,964	0,059
Aydin, 2010	1,888	0,308	0,095	1,285	2,491	0,000
Ates, 2007	2,439	0,403	0,163	1,649	3,230	0,000
Altinsoy, 2011	1,755	0,329	0,108	1,110	2,400	0,000
Tuysuz, 2015	0,937	0,205	0,042	0,534	1,339	0,000
Sakir, 2013	1,036	0,274	0,075	0,498	1,537	0,000
Kurt, 2009	10,604	0,867	0,752	8,905	12,304	0,000
Demiral, 2006	1,035	0,295	0,087	0,456	1,614	0,000
Altun, 2009	0,744	0,180	0,032	0,391	1,096	0,000
Gozum, 2011	0,947	0,269	0,072	0,420	1,475	0,000
Senel, 2016	1,319	0,282	0,079	0,767	1,871	0,000
Korkmaz, 2010	1,592	0,315	0,099	0,975	2,209	0,000
Elmaci, 2010	2,532	0,483	0,233	1,585	3,478	0,000
Akkus, 2009	-0,360	0,229	0,052	-0,809	0,089	0,116
Gurbuzoglu, 2009	0,606	0,253	0,064	0,110	1,102	0,017
Salap, 2007	0,797	0,308	0,095	0,193	1,402	0,010
Etli, 2007	0,912	0,245	0,060	0,431	1,392	0,000
Oral, 2006	0,673	0,160	0,026	0,359	0,986	0,000
Hepyasar, 2006	-0,819	0,379	0,143	-1,561	-0,077	0,030
Erkacan, 2006	0,510	0,240	0,058	0,039	0,981	0,034
Cirakoglu & Saracaloglu, 2009	1,146	0,283	0,080	0,593	1,700	0,000
Erkacan et al., 2012	0,495	0,240	0,058	0,025	0,966	0,039
Kurt, et al. , 2013	1,808	0,264	0,069	1,291	2,325	0,000
Ongoren & Sahin 2008	0,581	0,260	0,068	0,071	1,091	0,026
Akman, 2007a	0,965	0,301	0,090	0,376	1,554	0,001
Akman, 2007b	1,356	0,345	0,119	0,679	2,032	0,000
Çakan, 2006	0,301	0,312	0,097	-0,310	0,912	0,334
Moradaoglu, 2006	1,416	0,367	0,135	0,696	2,136	0,000
Kurt et al., 2011	0,345	0,116	0,013	0,117	0,572	0,003
Fixed Effects	0,801	0,039	0,002	0,724	0,878	0,000
Random Effects	1,024	0,111	0,012	0,806	1,242	0,000

When the individual effect sizes in the studies are examined, the study in which the effect size is negative and the smallest (Hepyaşar, 2006) has an effect size value of "-0,819". The study with the largest positive effect size (Kurt, 2009) has an effect size of "10,604".

As a result of the meta-analysis, separate effect sizes for the two models were calculated, but it is necessary to determine the study model first (Sutton, Abrams, Jones, Sheldon, & Song, 2000). The Heterogeneity funnel plot to determine the working model is given in Figure 1 below.

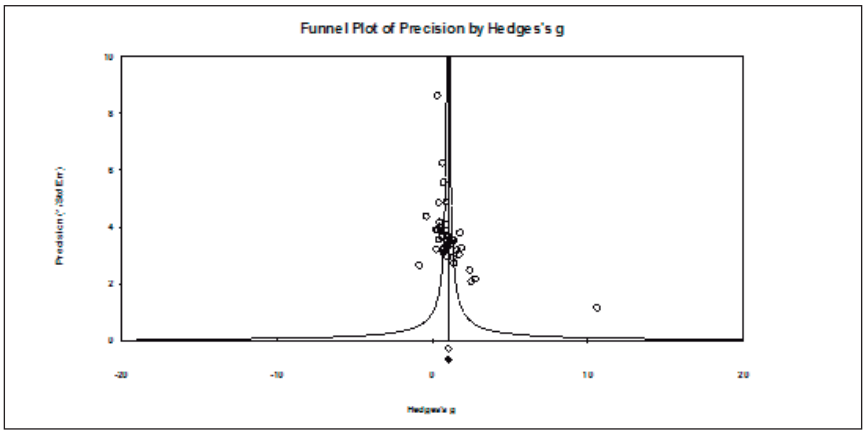

Figure 1. Distribution Funnel Plot of Effect Sizes According to Hedges' value

Information about the distribution and densities of the studies is given in the chart where the distribution of effect sizes is given with the calculations performed in CMA 2.0 used in meta-analysis. It is expected that almost all of the individual studies will take place in the funnel. The fact that the studies are also distributed outside of the funnel suggests that the frequencies of the studies show a heterogeneous distribution, but it is not sufficient. For this reason, it is necessary to test the heterogeneity of the studies and look at the "Q" or "p" values (Dinçer, 2014). Values are given in Table 4 below.

Table 4. Heterogeneity Test Results of Studies Examining Academic Success

Heterogeneity				Tau- Squared			
Q	**df**	**p**	**I^2**	Tau-squared	Standard Error	Variance	Tau
328,486	43	0,000	86,910	0,468	0,138	0,019	0,684

The heterogeneity test of the study was performed initially. As a result of the test, the Q statistical value was calculated as 328, 486 and the degree of freedom as 43. The critical value of the X2 table at 95% significance level is between 55,758 and 61,656. It was observed that the calculated Q statistical value exceeded the critical value determined in the chi-square distribution with 328.486 ($p < 0.05$) and 43 degrees of freedom. Based on this, it can be interpreted as "heterogeneous" for the distribution of the effect size of the study. It is considered appropriate to use Random Effects model for heterogeneous studies in model selection (Akgöz et al., 2004; Borenstein et al., 2009).

Since the individual studies in the study show heterogeneous characteristics, it is appropriate to make the selection of the model in this way, since it can eliminate mistakes (Gözüyeşil, 2012). The effect sizes of the study were calculated separately for both models and are given in Table 5. Since the appropriate model for the study is the Random Effects Model, the comments have been made accordingly (Lipsey & Wilson, 2001).

Table 5. Academic Success Combined Effect Sizes for the Meta-Analysis Study

Model	Number of Study	Effect Size	Standard Error	Variance	Sub Limit	Upper Limit	P
Fixed Effects	44	0,801	0,039	0,002	0,724	0,878	0,000
Random Effects	44	1,024	0,111	0,012	0,806	1,242	0,000

As a result of the meta-analysis, the effect size was calculated as 1,024. According to Cohen (1988) and Thalheimer and Cook (2002) classifications, the effect size is described as "large level". In addition, when the p value in the study is examined ($p < 0.05$), it is seen that it is significant. Based on this, it can be said that the multiple intelligence theory-based learning has a greater effect on academic success than the learning method proposed in the program.

Publication Bias

Studies with statistically significant results are more likely to be published than studies with negative results. This situation directly affects the literature-based meta-analysis research (Rothstein, Sutton, & Borenstein, 2005). Publication bias above a certain level may affect the calculated average effect size, making the calculated value higher than the true value (Borenstein et al., 2009). There are many methods to determine publication bias in the literature. In this process, especially Funnel Scatterplot, Clip and Fill, Rosenthal and Orwin's Fail-Safe N methods are widely used in studies (Üstün and Eryılmaz, 2014). Publication bias should be considered to examine studies that greatly affect the effect size of the study (Dinçer, 2014).

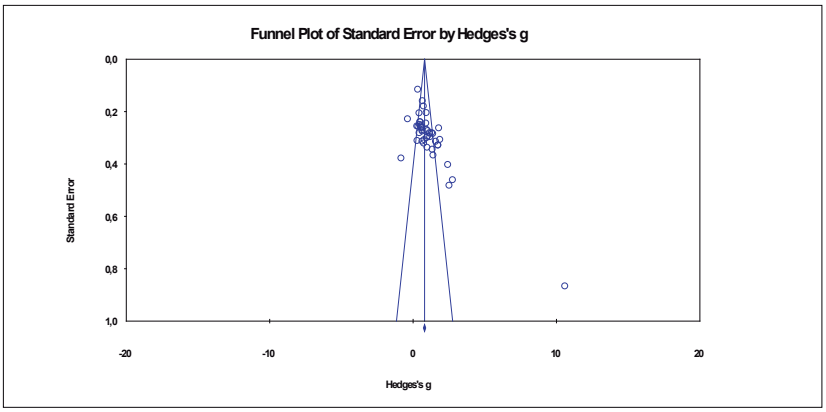

Figure 2. Academic Success Publication Bias Funnel Plot

When the graph of publication bias is examined, the section outside the funnel gives information about the publication bias. While the horizontal (x) axis gives information about the effect size, the vertical (y) axis gives information about the sample size or variance. The line dividing the funnel plot symmetrically indicates the overall effect size. It is expected that the studies will be gathered around the overall effect size and be symmetrical in the graph. The fact that most of the studies are in the funnel is important for the reliability of the study, as the studies outside the funnel may cause publication bias.

In this graphic, 11 works are seen outside the funnel. These studies constitute 25% of the study. However, the fact that the studies were not located very far from the funnel plot suggests that publication bias may be very insignificant. In order to show that the publication bias of the study is very insignificant, Classic Fail-Safe N and Kendall's statistics values are given in Table 6 below.

Table 6. Publication Bias Classic Fail- Safe N and Kendall's Statistics

Power of the Meta-Analysis	
Z- Value	22,754
p- Value	0,000
Alpha Value	0,05
Z- Value for Alpha	1,959
Sample	44
P> Number of missing studies required for alpha result	5887
Bias Condition	
Kendall's (P-Q)	458
Kendall's Tau	0,485
Z-Value for Tau	4,632
Kendall's p	0,000

As a result of publication bias analysis, Classic Fail-Safe N and Kendall's analysis were conducted. According to the data obtained, 5887 more studies should be added to the analysis so that the effect size of 44 studies included in the meta-analysis study can reach almost zero. In other words, 5887 studies should be included in the reverse direction of these data from the literature in order for the findings of this study, which included 44 studies, to be invalid. As a result of the literature review, it can be said that there is no publication bias in meta-analysis since it is not possible to reach this number of studies. When Table 6 is examined, it is concluded that there is no bias in the studies included in the meta-analysis.

As a result of the analysis of the studies, in order to see the general situation, the individual effect sizes of the studies that examine the academic success of the students in science education according to the Hedges g value and the forest graph showing the general effect size and the study weights are as follows in Figure 3

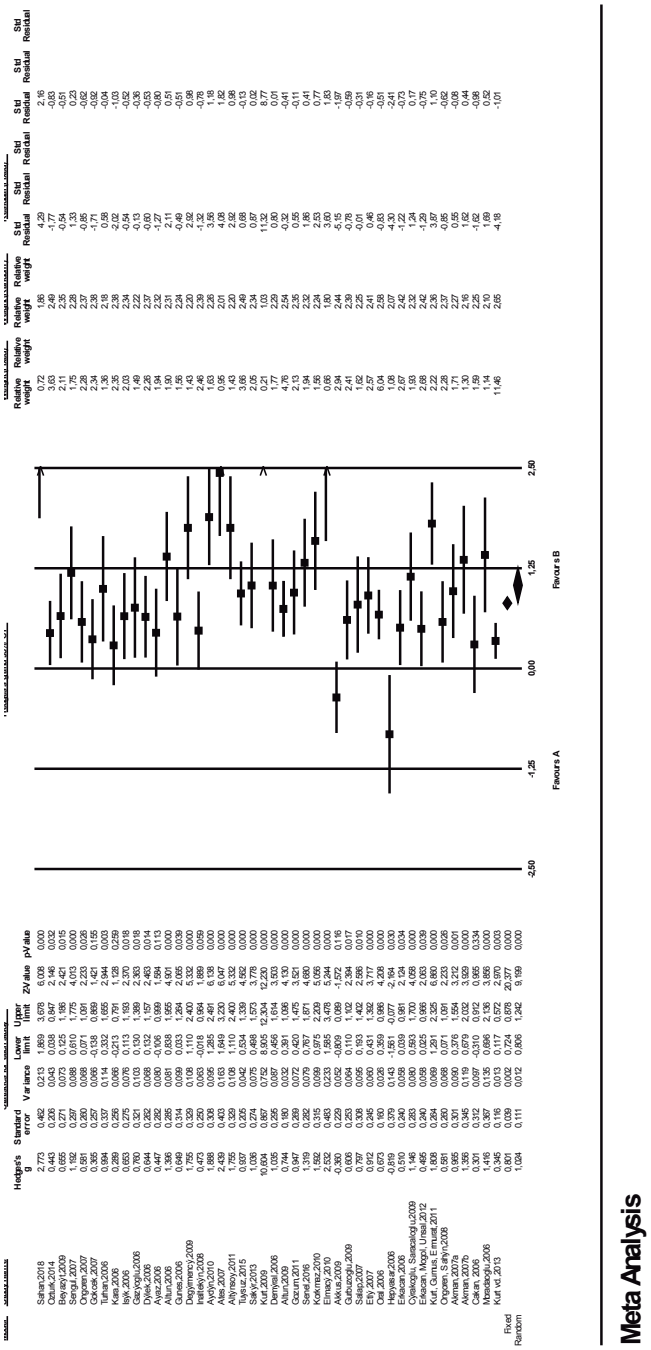

Figure 3. For Studies Examining Academic Success, Effect Size Distribution According to Hedges' g Value Forest Graph- Study Weight

When the forest graph of the studies is examined, the diamond symbolizing the effect size is seen in a value range greater than zero. This indicates that the multiple intelligence theory-based learning is more effective on academic success than the method proposed in the program.

Looking at the study weights, the data consist of values close to each other. The highest value for study weight (Kurt et al., 2013) is "2.65". Study weight values are expected to be close to each other. Values that are higher or lower than the study weights of other studies affect the study publication bias. Based on this, there is no publication bias in the study, as the values in the study show values close to normal.

Moderator Analysis by Science Field Variable

As a moderator in the meta-analysis study, "Is there a difference between the effect sizes in terms of academic achievement when the multiple intelligence theory is examined in terms of science course subtitles (Science Field: Physics-Chemistry-Biology)?" question has been explored. The degree of effectiveness of learning based on the theory of multiple intelligences in science education in terms of academic achievement of students in science fields was determined by comparative effect size values. Studies are divided into 3 different groups as physics, chemistry and biology. The results of the analysis performed are given below.

Table 7. Results on Effect Size by Science Field

Science Fields	N	Standart Eror	Q	dF	P	I	Overall Impact	Lower Limit	Upper Limit
Physics	14	0,068	57,306	13	0,000	77,315	0,617	0,484	0,751
Chemistry	10	0,087	60,474	9	0,000	85,118	1,073	0,903	1,243
Biology	20	0,058	192,249	19	0,000	90,117	0,812	0,698	0,925
Total Within (F.E.M.)			310,029	41	0,000				
Total Between (M.E.M.)			8,170	2	0,017		0,941	0,736	1,145

Considering the results of the heterogeneity test of the study, the fixed effects model was examined primarily. The significance level of the within-group heterogeneity test in the fixed effects model ($p<0.05$) was calculated. In addition, when the heterogeneity test Q statistical value of the study was examined, it was calculated as 310.029 and the degree of freedom was 41. The critical value of the X^2 table at the 95% significance level is between 55,758 and 61,656. It was observed that the calculated Q statistical value exceeded the critical value determined in the chi-square distribution at 41 degrees of freedom with 310,029 ($p<0.05$). From this point of view, it is said that the studies have the same widespread effect in themselves or the studies have a higher distribution than expected.

According to the results obtained, the mixed effects model was used and the p value was calculated according to the between-group heterogeneity test. The significance level of the test was calculated as ($p=0.017$)> ($p=0.05$). In addition, when the heterogeneity test Q statistical value of the study was examined, it was calculated as 8.170 and the degree of freedom was calculated as 2. The critical value of the X^2 table at the 95% significance level is 5,991. It was observed that the calculated Q statistical value was 8.170 ($p<0.05$), above the critical value determined in the 2 degree of freedom chi-square distribution. In addition, the p value was calculated as 0.017 and it was concluded that there was no significant value. In this case, it was concluded that there was no significant difference between the effect sizes of learning based on the theory of multiple intelligences on academic achievement in terms of science fields.

DISCUSSION, CONCLUSION AND SUGGESTIONS

While searching for an answer to the question "Does the multiple intelligences theory used in science education have a positive effect on students' academic success?", the effect sizes of 44 studies included in the meta-analysis were examined. When the effect size analysis is examined, it is seen that the study in which the

effect size is negative and the smallest belongs to Hepyaşar (2006) and has an effect size value of "-0,819". It is seen that the study with the largest effect size in the positive direction belongs to Kurt (2009) and has an effect size of "10,604". When looking at the overall studies included in the analysis, 95.45% of the studies have a positive effect and 4.55% have a negative effect. It can be said that the multiple intelligences theory-based learning has a positive effect on the academic success variable compared to the teaching method proposed in the program, as the majority of the studies have a positive effect. When the literature is examined, it is seen that there are similar results (Yurt & Polat 2015; Aydın, 2019). When the effect sizes of 44 studies are calculated, it is seen that 50% of the studies have large effect size according to the effect size classification of Cohen (1988) and 33.33% of the studies have medium effect size according to the effect size classification by Thalheimer & Cook (2002).

It was seen that the Q statistical value obtained as a result of the heterogeneity test performed to examine the distribution of the studies included in the meta-analysis exceeded the critical value determined in the chi-square distribution at 328.486 ($p < 0.05$) and 43 degrees of freedom. Based on this, it was concluded that the studies showed a heterogeneous distribution. The effect size of the multiple intelligence theory-based learning on academic success was found to be 1,024, positively. The equivalent of this value in the effect size classification is expressed as a large level. As a result of the examinations, it has been concluded that the effect of the multiple intelligence theory-based learning on academic success is more than the effect of the teaching method proposed in the program on academic success.

As a result of the literature review, the number of Meta-analyzes performed with the multiple intelligences theory is almost negligible. However, there are individual studies that show the positive effect of the multiple intelligence theory-based learning on academic success (Akman, 2007; Altun, 2006; Elmacı, 2010; Etli, 2007; Gökçek, 2007; Gürbüzoğlu, 2009; Korkmaz, 2010; Kurt, 2009; Öngören & Şahin, 2008; Şahan, 2018; Şenel, 2016; Şalap, 2007; Turhan, 2006). While examining the effects of studies in the field of science on academic achievement, the effects on physics, chemistry and biology branches were also examined. The effect sizes of the studies were calculated and when the studies were done, there were no great differences between the effect sizes. In addition, the impact aspects of the studies are also positive. When the effect size values were examined, it was found that the field of chemistry with the highest effect size was 1,301. When the overall effect sizes of the studies were examined, no significant difference was found between the groups. Based on this, there is no difference between science fields in terms of academic achievement. The following suggestions are given at the end of the research.

It is thought that the inclusion of the multiple intelligences theory in the lesson contents by the teachers who work in science education will increase the quality of learning. According to the meta-analysis results, it is seen that the multiple intelligences theory applied in teaching increases academic success. In-service trainings can be given for learning activities based on the multiple intelligences theory and benefit from these in-service trainings. Domestic studies were examined in the study carried out. Cross-country comparisons can be made for researchers who do not have time problems. The positive effect of the multiple intelligences theory-based learning on science education was revealed in this study. However, in a different study, when combined with other methods and techniques, the effectiveness of the Multiple Intelligence Theory on science education can be investigated. The effectiveness of the Multiple Intelligences Theory on science education in the study carried out; it was examined in terms of academic success variable. In other studies to be carried out, its effectiveness in different variables related to its permanence, reading skills, and decision-making skills can be examined. The effectiveness of the Multiple Intelligences Theory in science education was examined in the study carried out, its effectiveness in other disciplines (Mathematics, Turkish etc.) can be examined.

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ATTACHMENTS

Studies Included in the Meta-Analysis	
Study	Study Name
1	Şahan, A. (2018). *The effect of the education model based on the theory of multiple intelligences on the success and attitude ofstudents in the course,* Unpublished Master's Thesis, Kırıkkale University Institute of Sciences, Kırıkkale.
2	Öztürk, H. (2014). *The effects of multiple intelligences based instruction on students' achievement and attitude towards physics.* Unpublished Master's Thesis, Hacettepe University Institute Education of Sciences, Ankara
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4	Şengül, S.H (2007). *Effects of multiple intelligence theory based instruction on 6th grade primary school students' achievement of circularity system.* Unpublished Master's Thesis, Balıkesir University Institute of Science, Balıkesir.
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