THE META-ANALYSIS OF THE STUDIES ABOUT THE EFFECTS OF FLIPPED LEARNING ON STUDENTS' ACHIEVEMENT

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ABSTRACT

The aim of this research is to analyze the effect of the flipped learning model on the academic success of students. In this research featuring a descriptive survey model, a quantitative research method has been used. While criterion sampling method has been used for selecting the sample of this research, meta-analysis has been used to analyze the data. The inclusion and exclusion criteria of this study were as follows: Sources must be an article or a thesis; be studies performed in Turkey; have been published between 2014 and 2018; be open-access; the sampling must consist of students; they must examine the effect of the flipped learning model on success; have an experimental design; have pretest/posttest experimenting and a control group design; include data such as pretest and posttest standard deviation, arithmetic average, and sample size. 14 articles and 11 theses, 25 studies formed the study group.Document review technique has been used as data collection technique. As data collection tool, "meta-analysis form" developed by the researchers has been used. effect size values and unified effect sizes were calculated using Comprehensive Meta-Analysis (CMA) Software.After analysis was conducted based on the random effects model, it was determined that the effect of the flipped learning model on students' success is medium (Hedge's g=0.713). It has been seen that the variables of study type, educational level, and year do not have a significant effect on success (p>0.05). When the effect sizes were examined by year, newer studies had larger effect sizes, while the studies conducted with students at primary-secondary levels and with high school degrees had larger effect size averages.

Keywords: Flipped learning model, flipped classroom, meta-analysis, students' achievement, experimental studies.

INTRODUCTION

Rapidly changing and developing technology is now altering the way of life of society in many areas, from education to communication and from health to working life (Ucar & Bozkurt, 2018). Contemporary children and teenagers differ from their predecessors as they adapt to technology and gain continuous access to different communication channels such as mobile phones and social media (Oyman et al., 2013; Sariyer, 2015). With the wide use of information technologies and social media networks in education, diversified, different, and dynamic learning environments are necessary to educate the learners of this period (Wu & Li, 2015).

Today, one of the fields that has been most influenced by technological developments is education, and schools have had difficulties in keeping pace with the innovations in the world of production and the multiple needs of the new generation (Pinnelli & Fiorucci, 2015). Benefiting from instructional technology effectively in educating these students who are changing more considerably than the previous generation is seen as a necessity (Orhan et al., 2014). One of the methods actively used in instructional technology is flipped learning.

Defining the Flipped Classroom

The flipped learning model is a pedagogical approach emphasizing the formation of a student-centered learning environment and student attendance with the use of instructional and cooperative learning (McCallum et al., 2015; Reyna, 2015; Westermann, 2014). In the flipped learning model, technological equipment is utilized in the teaching and learning processes in a regular and systematical way (Strayer, 2012). Educators transfer the lessons to the students by means of videos outside of class, and time in class is spent on problem-solving and individual or group studies. This model helps form diverse instructional activities according to the learning styles of each student (Bergmann & Sams, 2012).

As the biggest barrier preventing active learning environments where students can learn by experience in class, the problem of time constraints can be solved and additional time can be provided by means of this model (Baker, 2000; Barak & Shakman, 2008). Students receive the necessary low-level information via instructional technology outside of class and they engage in activities to develop high-level thinking skills in class (Bergman & Sams, 2012; Strayer, 2012). In the flipped learning model, learning is not limited to only the classroom environment and students are required to strive and take responsibility for their own learning in accordance with their individual needs and learning speeds (Davies et al., 2013).

To explain flipped learning and to apply it better, 4 basic components were determined by the Flipped Learning Network, consisting of experienced educators, in 2013. These components were shaped around the theoretical framework of the flipped learning model, as well (Tetreault, 2006). Composing the acronym "F-L-I-P," these components are: 1) Flexible environment, 2) Learning culture, 3) Intentional content, and 4) Professional educators (Hamdan et al., 2013). Flipped learning environments must be flexible learning environments that educators and students can regulate at will. Educators must accept complicated and noisy environments in contrast with quiet and systematic classroom environments (Hamdan et al., 2013; Tetreault, 2006).This model has provided students with the ability to watch, listen, read, and revise subject material many times by removing the constraints of time and place (Enfield, 2013). In contrast to the traditional learning model, the educator stops being the source of information. By adapting a student-centered approach and encouraging students to explore the subjects more deeply, educators try to bring a learning culture to the students. In this student-centered system, educators guide students to reach information and check to see whether the students obtain that information or not with various testing methods (Grover & Stovval, 2013). The educators must design the content by thinking about which points are important, how they are related to the learning objectives, and where the students have the most difficulty (Hamdan et al., 2013). Educators are the heart of the matter in this model. They must observe the students continuously, give feedback, and evaluate them (Tetreault, 2006). They must guide the students in class and increase the interaction and communication with students (Flumerfelt & Green, 2013).

Aims of the Study

While scientific thinking is based on information building, it is a considerable undertaking to perform a comprehensive literature review in cases where study features and variables vary and it is difficult to group the results. Staton-Spicer and Wullf (1984) stated that the most suitable way of describing any field of study is to examine the research about that field, and studies examining the research in any discipline can lead the way for those who want to conduct research. Meta-analyses synthesize evidence from multiple studies and can potentially provide stronger evidence than individual studies alone (Mueller et al., 2018).

It is possible to identify many studies stating that flipped learning is effective on the academic success of students in the international literature (Baepler et al., 2014; Donovan & Lee, 2015; Green, 2015; Hamdan et al., 2013; Harvey, 2014; Marlowe, 2012; McCallum et al., 2015; Moravec et al., 2010; Strayer, 2012; Tetreault, 2006; Whitman Cobb, 2016; Zappe et al., 2009).

There are also many studies in the Turkish literature on the effect of the flipped learning model on success. Many studies have revealed that the flipped learning model has positive effects on success. For example, Sengel (2014) found that students participating in a flipped classroom performed as well as normal or better on a physics achievement test. Boyraz (2014) found that the test scores of test groups who were taught with a flipped classroom method were better than those of control groups taught with traditional teaching methods and the difference between the groups was meaningful. Ozpinar et al. (2016) concluded that students in a flipped learning group were more successful and had higher levels of motivation than students in a traditional learning group. Ekmekci (2017) found that there was a statistically significant difference between flipped learning and traditional learning groups' academic success levels. Sarigoz (2017) reported that the academic achievement of students studying according to the flipped classroom model increased more than the academic achievement of students studying according to the traditional education system. Sezer (2017) determined that a flipped classroom yielded both greater academic achievement and greater motivation compared with a traditional learning group. Cetinkaya (2017) found that there was a positive significant difference in favor of the flipped learning group compared to a traditional group. Cakir and Yaman (2018) found that students in flipped learning and traditional groups had a statistically significant difference in favor of the flipped learning group with respect to an achievement test in a science and technology course. Saglam and Arslan (2018) reported that a flipped classroom had a medium effect on students' academic achievements compared to traditional instruction. Sirakaya and Ozdemir (2018) determined that there was a significant difference between a flipped learning group and traditional groups in terms of academic achievement. Acarol (2019) found that flipped learning had a positive effect on student achievement and participation. In contrast, there are also studies showing that the flipped learning model does not have a significant effect on academic achievement. In her study, for example, Cabi (2018) found that there were no significant differences in students' academic achievements between an experimental group including students learning through the flipped learning model and a control group including participants taught according to traditional blended learning. Topal and Akhisar (2018) found that the flipped learning environment had no significant effect on the academic achievement of students.

Despite all these studies that revealed the effects of the flipped learning model on academic success, there is only one previous meta-analysis evaluating the overall success of flipped learning studies in Turkey (Orhan, 2019). Evaluating that study upon completion of the literature review performed for the present work, it is seen that Orhan (2019) included 8 theses and 5 articles about this subject but did not include 18 other relevant studies. Because of this gap in the literature, it is thought that a new meta-analysis of flipped classroom studies would provide useful insights into the implementation formats of the flipped classroom approach. In this context, the aim of this research is to analyze the effect of the flipped learning model on the academic success of students.

METHOD

Model

In this research featuring a descriptive survey model, a quantitative research method has been used. Survey models are research approaches aiming to describe a situation in the past or present in its own form (Karasar, 2015: 77), and a descriptive survey model can be expressed as a method of surveying and analyzing suitable articles as much as possible to provide the generalizability of the results (Avci et al., 2013).

Population and Sample

As one of the most commonly used purposeful sampling methods, the criterion sampling method has been used for selecting the sample of this research. Criterion sampling is the key criterion including common features of the subject and is seen as important by researchers (Ritchie et al., 2013).

A meta-analysis attempts to collate empirical evidence that fits prespecified eligibility criteria to answer a specific research question (Russo, 2007). The inclusion and exclusion criteria of this study were determined by the researchers considering the purpose of the research. The inclusion criteria were thus as follows:

1. Sources must be an article or a thesis.
2. They must be studies performed in Turkey.
3. They must have been published between 2014 and 2018.
4. They must be open-access.
5. The sampling must consist of students.
6. They must examine the effect of the flipped learning model on success.
7. They must have an experimental design.
8. They must have pretest/posttest experimenting and a control group design.
9. They must include data such as pretest and posttest standard deviation, arithmetic average, and sample size.

Initially, the search for articles was carried out in accordance with the criteria below via Web of Science, Taylor & Francis, SpringerLink, Scopus, ScienceDirect, Education Source, ERIC, EBSCO, PubMed, Sobiad, ULAKBIM, the ASOS Index, the Turkish Education System Index, and Google Academic:

- √ Key words: Flipped Learning, Flipped Classroom, Lesson at home – Homework at school
- √ Years: 2014-2018
- √ Source Type: Peer-reviewed Journal, Thesis
- √ Language: Turkish, English

As a result of the search, 3675 articles were listed. Of those, 111 presented studies performed in Turkey. Of these studies, 26 experimental studies examining the effects of the flipped learning model on success were determined. Articles produced from thesis works were not included in the study group if the full text of the thesis itself could be accessed. The contents of the experimental studies were examined in detail and 19 articles having a pretest/posttest experimental control group design were identified. The authors of seven articles whose arithmetic average and standard deviation values were not provided were contacted by e-mail to request those values. The necessary values were obtained from only 2 authors. As a result, 14 articles were included in the study group.

A flow diagram summarizing the process of selecting the studies is presented in Table 1.

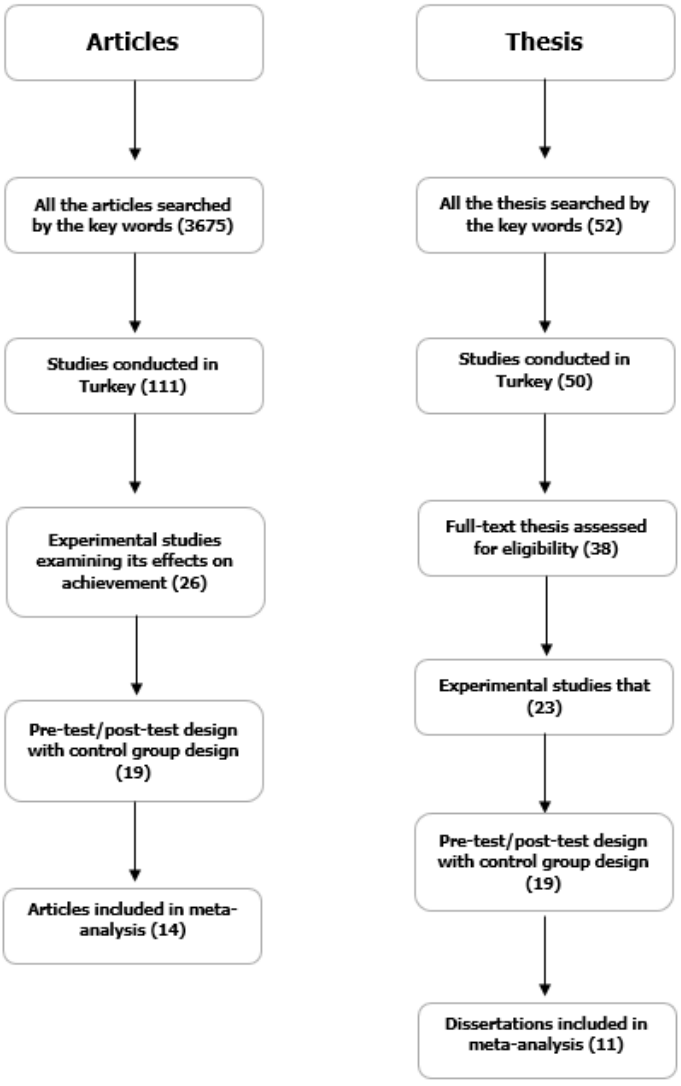

Figure 1. The Flow Diagram of Selecting the Studies

In the process of selecting theses, the search was initially carried out via the National Thesis Center in accordance with the following criteria:

- √ Key words: Flipped Learning, Flipped Classroom, Lesson at home – Homework at school
- √ Years: 2014-2018
- √ Language: Turkish, English
- √ Place: Turkey

As a result of the search, 52 theses were listed and 50 of them were completed in Turkey. Twelve of them could not be obtained due to access restrictions. Of the 38 theses that could be accessed, 23 experimental studies examining the effect of the flipped learning model on success were determined. The contents of these experimental studies were examined in detail and in 12 theses a pretest/posttest experimental control group design was determined. One of these did not provide the arithmetic average and standard deviation values and so an e-mail was sent to the author requesting them. The author did not provide the necessary data and, as a result, 11 theses were included in the study group.

Comparing the selected articles with the theses whose full text had been obtained, only one article produced from those theses had been considered for the study group. Thus, with 14 articles and 11 theses, 25 studies formed the study group.

When these studies were examined, the effect size of each study was calculated separately considering that in some cases the flipped learning model was carried out in "social science" and "science" lessons with 2 separate experiment groups for each lesson. As a result, 28 datasets were included in the study group.

The frequencies and percentage values of the studies included in the research for variables such as "year of the study," "study type," and "sampling level" are presented in Table 1.

Table 1. Descriptive Statistics

Studies		f	%
Year	2014	1	3.57
	2015	1	3.57
	2016	6	21.43
	2017	8	28.57
	2018	12	42.86
	Total	28	100
Study Type	Article	14	50
	Post Graduate thesis	8	28.57
	Doctoral Thesis	6	21.43
	Total	28	100
Sampling level	Primary School	4	14.29
	Secondary School	4	14.29
	High School	1	3.57
	Associate Degree	2	7.14
	Undergraduate	17	60.71
	Total	28	100

As seen in Table 1, 28 datasets obtained between 2014 and 2018 were included in the study. Many of them were obtained in 2018. Several of the them were postgraduate theses. It was seen that 60.71% of the studies had data collected from among undergraduate students when the sampling levels were examined. Studies of high school and primary school students were least common in the sampling.

Data Collection

As a data collection technique, document reviewing has been used. Document reviewing is the process of reaching independently verified data by reviewing the available sources. The process of document reviewing presents a systematical format to researchers to acquire, analyze, and produce beneficial information from the available documents (Kilic et al., 2019). In this research, the reviewed documents are articles and theses.

Developed by the researchers in accordance with the research problems, a meta-analysis form has been used as a data collection tool. For the data input of the coding form, Microsoft Excel has been used.

The information below was included in the form:

- √ Information about the study (title of the study, the name of the author(s), the year when the study was carried out, the city where the study was carried out, study type, educational level of the sampled students, where the study was published).
- √ Statistics from the study (pretest standard deviation, pretest arithmetic average, pretest sampling size, posttest standard deviation, posttest arithmetic average, posttest sampling size).

Initially, to avoid publication bias in the scope of reliability studies:

- √ The literature was reviewed in detail.
- √ Inclusion criteria and exclusion criteria were determined in detail objectively.
- √ A coding form was created.
- √ The theses were searched and coded by one researcher while the articles were searched and coded by another researcher.

Data Analysis

For data analysis, meta-analysis has been used. Meta-analysis is a quantitative technique that uses specific measures to indicate the strength of variable relationships for the studies included in the analysis. The technique emphasizes results across multiple studies as opposed to results from a single investigation (Shelby & Vaske, 2008). Meta-analysis studies are seen as studies creating significance for the whole of the literature and readers as they present the sampling size for each study included, compare the sampling sizes to others, and present a final sampling size (Kilic et al., 2019).

Initially, a heterogeneity test was carried out, and then effect size values and unified effect sizes were calculated using Comprehensive Meta-Analysis (CMA) Software. For calculating effect sizes, a format was selected where pretest and posttest calculations of the experimental and control groups (arithmetic average, standard deviation values, sampling quantities) could be included. For calculating effect size, Hedge's g-factor was used. Whether or not there was publication bias in the studies included in the meta-analysis was then examined by funnel plot, classic fail-safe N analysis, and Begg and Mazumdar rank correlation test. To provide symmetry, Duval and Tweedie's "trim and fill" method was used.

FINDINGS

Heterogeneity

Basically, there are two sources of variability explaining the heterogeneity in a meta-analysis. One of them is within-run variability, which results from sampling error. Sampling error is possible in every meta-analysis study because every study uses different samplings. Another source of heterogeneity is the variability between studies. This situation results from the effects of the changes made in the research and the quality and features of the research (Tania et al., 2016). While determining the present heterogeneity, the criteria below were examined:

- √ In the analysis of Q statistics expressed as the sum of weighted squares, the hypothesis that all studies share the general influence was tested. As a result of this analysis, it is determined whether there is heterogeneity by examining the p-value (Borenstein et al., 2009).
- √ If the level of significance is below the p-value, it is concluded that there is a significant difference between the studies. That means that there is no heterogeneity between the studies (Dincer, 2014).
- √ The I^2 statistics give information about the rate of heterogeneity. If the I^2 value is higher than 75%, it means that influence quantities are heterogenic (Higgins & Green, 2011).
    - 0-40%: Very low level of heterogeneity
    - 30-60%: Medium level of heterogeneity
    - 50-90%: Sufficient level of heterogeneity
    - 75-100%: High level of heterogeneity

The values related to these calculations are presented in Table 2.

Table 2. The Results of Heterogeneity Test

Q-value	Sd (Q)	p-factor	I^2
148.026	27	0.000	81.76

p<0.05

According to the results of the heterogeneity test, the Q statistics (Q=148.026; p<0.00) showed that the influence quantities of the studies did not have a homogeneous distribution. The value of I^2 calculated as a supplement for Q statistics is a high-level indicator of heterogeneity.

Effect Size

First of all, it was determined whether effect size would be calculated according to the fixed effects model or random effects model. Which statistical model will be used is generally a complicated and subjective decision. However, there are some criteria to direct the decision about which model to use. The first criterion is to consider the aim of the statistical inference. If there is an aim of generalizing beyond the studies whose results are included, the random effect model is a suitable statistical model for meta-analysis. The second criterion to be considered is related to the number of studies included in the meta-analysis. The fixed effects model is a suitable model when the number of studies is less than 5. The third criterion is whether there is statistical heterogeneity between effect sizes or not. If there is heterogeneity, the fixed effects model is not suitable. In this case, the random effects model can be used (Tufanaru et al., 2015). In this research, the usage of the random effects model is suitable as it is seen that there is generalization beyond the studies whose results are included, the number of the studies included in the meta-analysis is greater than 5, and the rate of heterogeneity is high.

The findings related to each study in the sampling acquired by analysis via the random effects model and the general effect level of the studies are presented in Table 3.

Table 3. Findings of Influence Quantity

Name of the Study	Hedges's g	Standart Error	Variance	Lower Limit	Upper Limit	z Value	p Value
Akgun & Atici, 2017	0.887	0.254	0.064	0.390	1.384	3.498	0.000
Aydin, G., 2016	0.368	0.344	0.118	0.307	1.042	1.069	0.285
Aydin, B., 2016	1.382	0.332	0.110	0.732	2.032	4.165	0.000
Balikci, 2015	0.523	0.341	0.116	0.145	1.191	1.535	0.125
Boyraz & Ocak, 2017	0.952	0.331	0.110	0.303	1.601	2.876	0.004
Cabi, 2018	0.275	0.259	0.067	0.231	0.782	1.065	0.287
Cakir, 2017	1.024	0.288	0.083	0.459	1.590	3.552	0.000
Cavdar, 2018	0.225	0.204	0.042	0.175	0.624	1.103	0.270
Cetinkaya, 2017	0.596	0.235	0.055	0.135	1.057	2.535	0.011
Debbag, 2018	1.592	0.258	0.067	1.086	2.098	6.168	0.000
Demir, 2018Fa	1.731	0.365	0.134	1.014	2.447	4.736	0.000
Demir, 2018Fb	2.696	0.432	0.187	1.849	3.544	6.236	0.000
Demir, 2018Sa	1.836	0.372	0.138	1.107	2.565	4.939	0.000
Demir, 2018Sb	1.334	0.344	0.118	0.660	2.009	3.879	0.000
Ekmekci, 2017	2.066	0.374	0.140	1.334	2.799	5.528	0.000
Hava & Gelibolu, 2018	0.383	0.261	0.068	0.129	0.895	1.466	0.143

Iyitoglu, 2018	0.873	0.321	0.103	0.244	1.503	2.719	0.007
Koroglu & Cakir, 2017	1.413	0.319	0.102	0.788	2.037	4.433	0.000
Ozpinar et al., 2016	0.924	0.293	0.086	0.349	1.499	3.149	0.002
Saglam, 2016	0.862	0.276	0.076	0.321	1.403	3.125	0.002
Sarigoz, 2017	1.251	0.263	0.069	0.736	1.766	4.762	0.000
Sengel, 2014	0.160	0.231	0.063	0.293	0.613	0.691	0.490
Sengel, 2016	0.764	0.212	0.045	0.349	1.180	3.606	0.000
Sezer & Abay, 2018	4.629	0.619	0.383	3.416	5.841	7.481	0.000
Sezer, 2017	0.794	0.249	0.062	0.306	1.283	3.186	0.001
Sirakaya & Ozdemir, 2018	0.274	0.245	0.060	0.205	0.753	1.121	0.262
Yavuz, 2016	0.173	0.374	0.140	0.561	0.906	0.461	0.644
Yurtlu, 2018	2.159	0.388	0.151	1.398	2.920	5.562	0.000
Fixed	0.895	0.055	0.003	0.788	1.002	16.359	0.000
Random	1.068	0.130	0.017	0.812	1.324	8.184	0.000

When Table 3 is examined, it is seen that the relationship between success and the flipped learning model in all 28 datasets acquired from the 25 studies included in the research is positive and in 20 of these studies it is statistically significant ($p<0.05$). According to the fixed effects model, the value of effect sizes between the flipped learning model and success is 1.068, while it is 0.895 according to the random effects model. Both effect sizes are positive, at high levels, and statistically significant ($p<0.05$). Based on the values of the effect sizes, it can be said that there is a high-level positive relationship between the flipped learning model and success. Information on the effect sizes of each study is given in Table 4.

Table 4. Influence Quantity Levels

Influence Quantity Level		Studies	f
Lower than0,15	Trivial effect	-	-
0,15-0,40	Small effect	Sengel, 2014; Yavuz, 2016; Cavdar, 2018; Sirakaya & Ozdemir, 2018; Cabi, 2018; Aydin, G., 2016; Hava & Gelibolu, 2018	7
0,40-0,75	Medium effect	Balikci, 2015; Cetinkaya, 2017	2
0,75-1,10	Large effect	Sengel, 2016; Sezer, 2017; Saglam, 2016; Iyitoglu, 2018; Akgun & Atici, 2017; Ozpinar et al., 2016; Boyraz & Ocak, 2017; Cakir, 2017	8
1,10-1,45	Very large effect	Sarigoz, 2017; Demir, 2018Sb; Aydin, B., 2016; Koroglu & Cakir, 2017	4
Higher than1,45	Perfect effect	Debbag, 2018; Demir, 2018Fa; Ekmekci, 2017; Demir, 2018Sa; Yurtlu, 2018; Demir, 2018Fb; Sezer & Abay, 2018	7

As is seen in Table 4, 7 of 28 datasets are at a perfect level, 4 of them are at a very high level, 2 of them are at a medium level, and 7 of them are at a low level. Among the studies, there are none having effect size at a trivial level.

To determine whether there is a significant difference between effect sizes according to the level, the study type, and the year of the study, homogeneity tests were carried out. Regarding the years of the studies, the years of 2014 and 2015, each of whose subgroup number is 1, have not been counted in the homogeneity analysis. The results acquired from this test are given in Table 5.

Table 5. The Results of Homogeneity Test

Moderator	Variable	N	Influence quantity (d)	S. Error	Sampling size		(Q)	df	p
					Below	Above			
Level	Associate, Undergraduate degree	19	1.017	0.164	0.695	1.339	0.377	1	0.539
	Primary, Secondary, High School Degree	9	1.182	0.213	0.764	1.600			
Study Type	Article	14	0.969	0.179	0.618	1.319	0.590	1	0.442
	Thesis	14	1.170	0.192	0.794	1.546			
Year	2016	6	0.773	0.150	0.478	1.067	4.598	2	0.100
	2017	8	1.072	0.144	0.789	1.355			
	2018	12	1.408	0.283	0.853	1.962			

According to the results of the homogeneity test in Table 5, there is no statistically significant difference between groups according to the level of education (Q=0.377, p>0.05), study type (Q=0.590, p>0.05), and year of the study (Q=4.598, p>0.05). When the results of moderator analysis are considered, it is seen that variables such as the level of education, study type, and year of the study on average do not have a moderator role at the level of influence calculated for the flipped learning model.

Publication Bias

The possible existence of publication bias in the studies included in this meta-analysis was evaluated via funnel plot. Funnel plots are based on the reality that precision in estimating the common effect of studies increases as long as the sampling size increases. The results acquired from small studies will be scattered under large-scale plots and this will be narrowed moving toward bigger studies. In the event that there is no publication bias, the resulting graphic will resemble a symmetrically inverted funnel. On the contrary, funnel plots will be generally curved and asymmetrical in the event of publication bias (Egger et al., 1997). The funnel plot acquired from this research is presented in Figure 2 below.

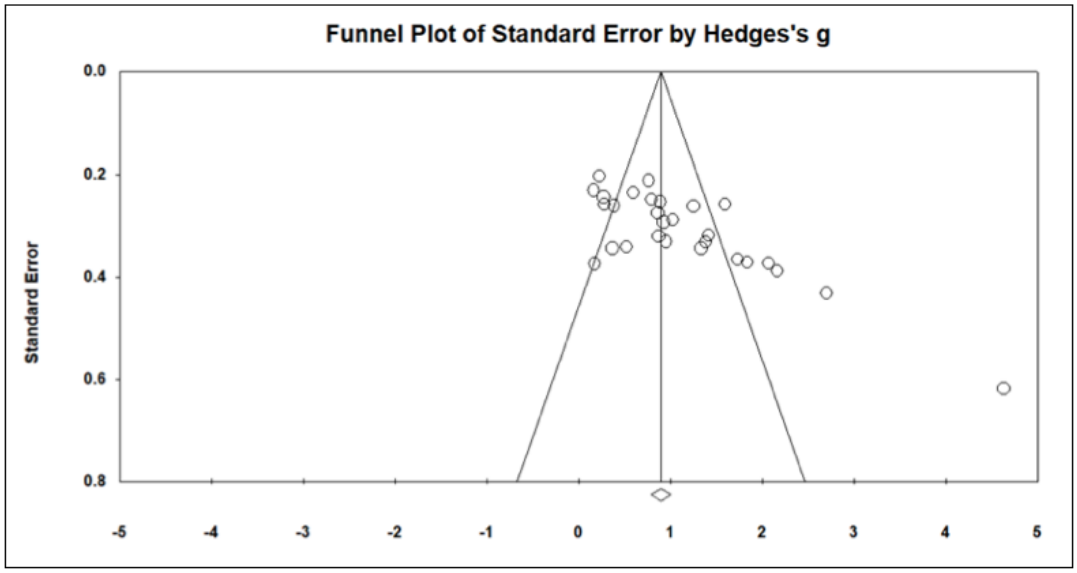

Figure 2. Funnel Plot

When the funnel plot in Figure 2 is examined, it can be said that the studies are not in symmetry and there is publication bias, but the effect size of the studies differs between 0.16 and 4.629. Thus, there is not a big deviation, except for the study coded as M10, whose publication bias deviated more substantially from the limit value and whose effect size is 4.629.

Another way to determine the bias is by calculating the classic fail-safe N value. By doing this, an effort is made to determine how many studies are necessary to invalidate the effect size (Borenstein et al., 2009). Values related to this analysis are presented in Table 6.

Table 6. Classic Fail-Safe N Value

Meta-analysis Power	
Z-score	17.886
p-value	0.00
Alfa value	0.05
Z score for Alfa value	2.00
N	28
p> the number of necessary studies for the result of alfa	2304

In classic fail-safe N analysis, the p-value being smaller than the alpha value shows that the study is strong and reliable. As seen in Table 6, the p-value is smaller than the alpha value for this research. The necessary value to invalidate the result of the meta-analysis is 2304. This value represents that there should be 2304 studies having opposite findings in the related literature. When it is considered that the effect size of 28 studies has been calculated, it is seen that the number 2304 is too high. These 28 studies included in the sampling are the absolute amount of studies reached according to the criterion of including all the studies aimed at this research question in Turkey. This case decreased the publication bias in this meta-analysis study.

To present the bias of the study sample statistically, the rank correlations of Begg and Mazumdar have been applied. The rank correlation of Begg and Mazumdar is a test of publication bias. The Kendall tau values between standardized effect size values and their variances are calculated. The values acquired show the relationship between effect size and sampling size. If there is a significant correlation ($p<0.05$), it can be said that there is publication bias (Begg & Mazumdar, 1994). The results of the analysis acquired from this test are presented in Table 7.

Table 7. The results of Begg and Mazumdar Rank Correlations

Case of Nias	
Tau	0.534
Tau's Z score	3.99
p value (1-tailed)	0.000
p value (2-tailed)	0.000

As the p-value (one-tailed p-value) acquired in the analysis is >0.05, it can be said that there is publication bias in the examined studies.

To provide symmetry, corrections have been made using the "trim and fill" method of Duval and Tweedie. The trim and fill algorithm is based on formalizing the case by using a funnel plot. After determining that this study was asymmetrical, the asymmetrical parts of the funnel were determined and this correction was added on the opposite side to provide symmetry (Duval & Tweedie, 2000).The new graphic is presented in Figure 3.

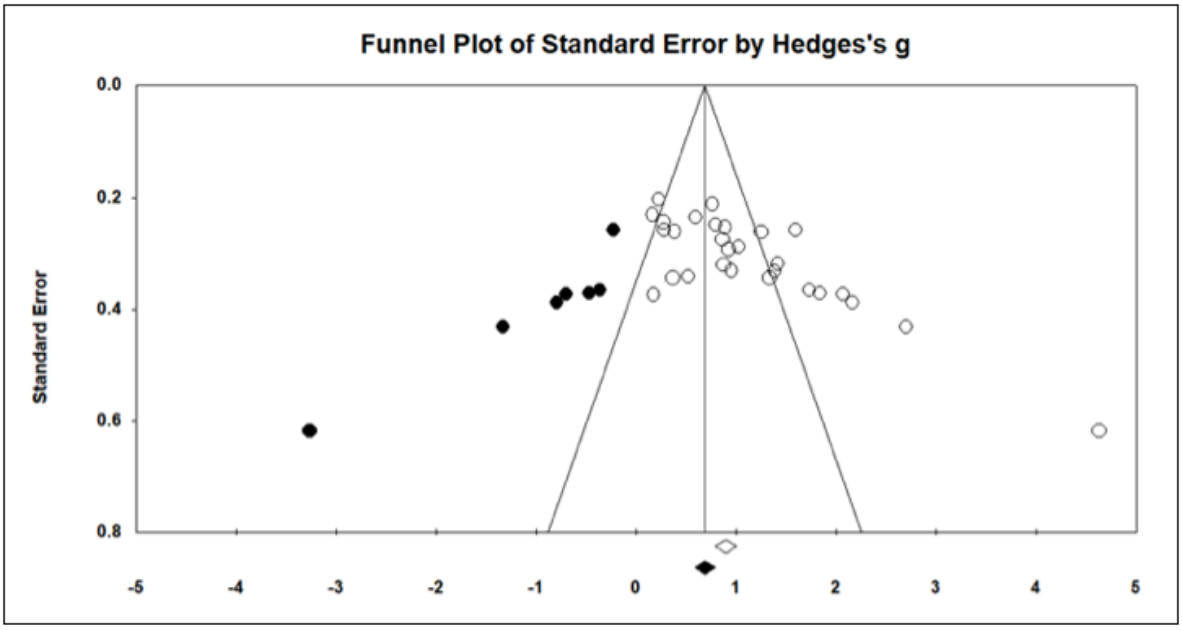

Figure 3. The Graphic resulted from Trim and Fill Method

As it is seen on Figure 3, it is seen that the symmetry has been formed by adding 7 studies to the left side as a result of correction made. By using this method, -being formed to correct the effect resulted from publication bias according to random effects model – new effect value is 0.713.The final value expresses the medium level effect size. By comparing the first analysis based on random effects model, the difference resulted from the effect size has shown that the possibility of research to be published is higher than the studies examining the effect of flipped learning model on success.

As seen in Figure 3, symmetry was achieved by adding 7 studies to the left side as a result of the correction made. By using this method to correct for the effect of publication bias according to the random effects model, the new effect value is 0.713. This final value expresses a medium-level effect size. Compared to the first analysis based on the random effects model, the difference resulting from the effect size shows that the possibility of research being published is higher than the studies examining the effect of that flipped learning model on success.

DISCUSSION

In this meta-analysis study, the aim was to examine the effect of the flipped learning model on success. After analysis was conducted based on the random effects model, it was determined that the effect of the flipped learning model on students' success is medium (Hedge's g=0.713) as a result of additional analysis being conducted based on publication bias. The results acquired from the research demonstrate that instructional activities carried out according to the flipped learning model increase students' success with a standard deviation of 0.71. For example, the increase for a test whose average is 550 and standard deviation is 100 (621 points instead of 550) seems fairly effective. It has been seen that this effect size, which is seen to be important within the context of education, is higher (d>0.4) than the Hattie critical effect size required to focus on the success of students. The confidence intervals related to the effect size acquired from the studies examined show that the results are reliable (Borenstein et al., 2009).

Karagol and Esen (2019) reviewed the results acquired from foreign studies and studies published in Turkey and included 55 studies (both articles and theses) on the effects of flipped learning activities on academic success in their meta-analysis. The average effect size related to those studies was calculated as 0.56. Orhan (2019) found the effect size as 0.74 in a meta-analysis study conducted with a total of 13 studies (8 theses and 5 articles). However, it was seen that the heterogeneity value of the results was very low as a limited number of studies were included in the research. In a study conducted in Korea, Choe and Lee (2018)

evaluated 95 research studies conducted among different educational levels (59 of them were theses and 36 of them scholarly articles) regarding the effects of flipped learning activities on academic success via meta-analysis. According to the results, they inferred that the effects of flipped learning activities on students' learning levels are at a medium level (d=0.58). It is stated that the contributions of flipped learning activities to students' cognitive, affective, and interpersonal learning outcomes are at different levels. As a result of a meta-analysis study conducted based on the results of 46 studies, most of which were carried out in the field of health sciences, Chen et al. (2018) inferred that flipped learning activities yielded more successful results than teacher-centered activities and these activities had a medium-level effect (d=0.47) on students' success. They also reported that flipped learning activities generated different results in information and skill-based evaluations of success. Hew and Leo (2018) counted flipped learning activities published for the health sciences and found 28 studies comparing traditional class activities in terms of students' success in a meta-analysis. With this research conducted comparatively, they inferred that flipped learning had a small effect (d=0.33) on increasing students' success. As a result of meta-analysis studies conducted with 11 works on the effects of flipped learning activities on students' success and satisfaction levels, Van Alten et al. (2019) inferred that flipped learning activities had a low-level effect size (g=0.36) on students' success. In the meta-analysis study of Tutal and Yazar (2017) involving 52 empirical studies conducted in Turkey and abroad on the flipped learning model, it was concluded that flipped learning had a moderate and positive effect on the academic achievement of the students compared to the traditional method. In the study conducted by Margulieux, McCracken, and Catrambone (2015), it was concluded that students' academic achievement increased in most of 21 studies using the flipped learning model.

In comparison with the other studies in the literature, Chen et al. (2018) gathered works conducted in different disciplines together in their meta-analysis. In this study where the results of flipped learning activities were considered, the results of 55 studies on this subject were presented as a result of research in 17 different databases. As a result of the effect size calculations, they emphasized that these activities had a low-level effect (d=0.19) on students' success. Compared to other studies, this study is interesting as it was conducted with works from different disciplines and because of its low-level effect size. It was seen that a large amount of these studies from the international literature were carried out in the fields of medicine and health science. In one such study, Gilette et al. (2018) inferred that the effects of flipped learning activities on students' success were not statistically significant, while the existence of studies in the literature with high-level effect sizes like 1.06 and 1.68 has drawn attention (Hu et al., 2018; Tan et al., 2017). Likewise, Betihavas, Bridgman, Kornhaber, and Cross (2016), who systematically examined 21 articles on flipped learning usage in nursing education, concluded that flipped learning affected academic achievement in one of three experimental studies that they included in their research. No significant difference was found between the traditional method and flipped learning in terms of academic achievement in two of them. As a result of the research, it was concluded that the effect of flipped learning activities on students' success is not clear enough. However, it can be said that a medium-level effect size is a common result. In this regard, it can be said there is a similar effect in this study carried out in Turkey.

In this research, it has been seen that the variables of study type, educational level, and year do not have a significant effect on success ($p>0.05$). When the effect sizes were examined by year, newer studies had larger effect sizes, while the studies conducted with students at primary-secondary levels and with high school degrees had larger effect size averages. The nonsignificant results in terms of educational level and study type are consistent with other meta-analysis results determined in terms of educational level (Cheng et al., 2019; Val Alten et al., 2019) and publication (Lag & Sæle, 2019). On the other hand, Xu et al. (2019) inferred that there is a significant difference in favor of secondary school degree in the comparison of higher education and secondary education. Chen et al. (2018) reported a significant difference in terms of year and publication type as a result of moderator analysis limited to studies carried out at the undergraduate level in the field of health. When the significant results in the literature as a result of moderator analysis were examined, it was seen that newer research by years, articles and conference proceedings in terms of publication types, and primary and secondary school degrees had a high-level effect. Tan, Yue, and Fu (2017) concluded that there is no significant difference between the effect size of studies on flipped learning with associate degree students and the effect size of those on flipped learning with undergraduate students.

It has been seen that there was publication bias in 28 studies examining the relationship between flipped learning and success in Turkey. The final effect size value (d=0.713) reached in the research was calculated by considering the publication bias. When the bias level in the studies about the effects of flipped learning activities on success in the literature was examined, it was seen that there were biased results in the research conducted by Lag and Saele (2019). Comparing the first analysis results to the final results, a serious decrease in effect size values was observed (from d=0.35 to d=017). While in the results of the research having low-level effect size results (d=0.19) conducted by Chen et al. (2018) it was stated that there was no bias, in another study having low effect size (d=0.20) conducted by Van Alten et al. (2019) bias was reported. As a result of research having low-level effect size results (d=0.19) Chen et al. (2018) found no bias, while in by. In large effect size studies conducted by Xu et al. (2019), Hu et al. (2018), and Tan et al. (2017), the risk of low-level bias resulting from the quality of the included works (design of the research) was noted. However, statistically significant bias values were not encountered, although statistically significant bias values were found in research having very large effect size values (d=1.79) conducted by Xu et al. (2019). Meta-analysis studies have mostly reported significant results and so they are open to the risk of having publication bias as they include published studies. The low or high number of studies included in the research will not be a solution to overestimating that may occur due to publication bias. A minority or a majority of the studies included in the research cannot be the solution to the studied hypothesis because of publication bias (Nuijten et al., 2015). It has been seen that a serious difference occurs in estimating the effect size of publication bias in both this research and the literature. If the studies included in meta-analysis as in this study are not resistant to publication bias, integral secondary analysis is necessary by applying analysis techniques regarding publication bias (Augusteijn et al., 2019).

CONCLUSION AND SUGGESTIONS

This research has shown us that studies related to flipped learning model applications in Turkey reveal that flipped learning activities can contribute to the success of Turkish students. According to the international literature, the impact of the flipped learning model on student achievement has a medium effect size. In this regard, it can be said there is a similar effect in this study carried out in Turkey. In this research, it has further been seen that variables of study type, level of education, and year do not have a significant effect on success and that there has been publication bias in Turkey.

In consideration of the results of the works included in this meta-analysis and conducted within many different disciplines, the assessment types used by researchers in relation to the efficiency of the flipped learning model (information tests, skill tests, etc.) are different from each other in terms of the learning outcomes seen as students' success (cognitive, affective, etc.) and in class activities. Particularly in higher education, the effect of flipped learning activities on students' success is not completely clear yet (O'Flaherty & Phillips, 2015). However, it is clear that meta-analysis and meta-synthesis studies have important contributions to new studies. According to the results of this research, the following suggestions were developed:

1. In this study, comparisons were made over a common effect size value. Research dealing with variables such as flipped learning activities, learning outcomes, etc. can also be done. This will present a different perspective in understanding the rising effect. Also, such research will contribute to the results of in-class activities in research where flipped learning activities are carried out to be understood and the strategic approaches contributing to the students' performance in the teaching and learning process are to be realized.
2. This study examines the effect of flipped learning on only academic achievement. The effects of flipped learning on factors such as attitude, self-efficacy, and motivation can also be analyzed through meta-analysis in future studies.
3. After further studies are carried out to increase the diversity of the sample group, meta-analysis can be repeated and healthier results can be obtained regarding the results of the effect size of the sample group's education level.
4. A meta-analysis study can be carried out with studies investigating the impact of the flipped learning model on academic achievement outside of Turkey and the results can be compared with this study.

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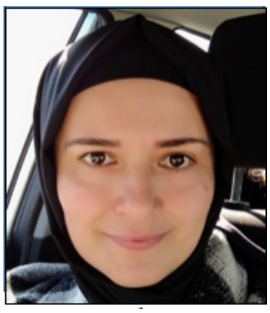

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