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Does gamification affect academic achievement? A meta-analysis of studies conducted in Turkey

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Abstract

Gamification helps to make learning fun and motivate students by attracting the attention of students. In the literature, it is seen that the studies conducted to determine the effect of gamification of learning on academic achievement have reached contradictory results. While some studies have found that gamification increases academic achievement, some studies report that gamification of learning has no effect on academic achievement. In this direction, the aim of the study is to examine the effect of gamification of learning on academic achievement through meta-analysis. Some moderator analyses were also carried out to determine the exact efficiency of gamification in terms of kinds of games (digital and non-digital games), publication year, school subjects in which games were used, class sizes, student levels. In this context, master's thesis, doctoral dissertation and articles that were conducted between 2010 and 2020, were appropriate for the research problem and had statistical data to be included in the meta-analysis study were reviewed and investigated in Turkish and English from databases. As a result of the literature review, 1746 studies were reached. Among these studies, it was determined that 52 studies met the inclusion criteria. According to the research findings, it is possible to allege that Cohen d value which was estimated to be .862 for the overall effect size of gamification learning on student achievement indicates a large effect. In the study, it was determined that the effect size of academic achievement did not differ significantly according to the student levels, publication years, and class sizes. Moreover, it was determined that the widespread effect size on academic achievement differed significantly according to kinds of games and school subjects in which games were used. In this context, it can be said that gamification is an effective method for teaching.

Keywords: Gamification; meta-analysis; academic achievement

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1. Introduction

1.1. Introduce the problem

Today, educational institutions in many countries aim to increase their active participation and motivation in the learning process by including gamification in teaching activities that students find boring (Spathopoulou, 2019). Gamification is defined as enriching products, services, and information systems with game design elements to positively affect users' motivation, productivity, and behavior (Huotari & Hamari 2012; Deterding et al. 2011). In the context of learning, gamification is expressed as gamified learning (Armstrong & Landers 2017; Landers 2014). The purpose of gamification in learning is to directly affect the behavior and attitudes related to learning (Landers, 2014).

Gamification seems to be increasing in popularity both in industry and in teaching (Landers, 2015). In serious games used for teaching purposes, there are serious goals in education, health, trade, social awareness before entertainment (Yıldırım & Şen, 2019; Michael & Chen, 2005). In terms of achieving these goals, the relationship between gamification and learning is very important. Therefore, attention is drawn to four components in gamified learning theory: instructional content, behaviors and attitudes, game characteristics, and learning outcomes. In theory, it is claimed that the content of the instruction has a direct impact on the learning outcomes as well as the behavior of the students. Since gamification is used to improve teaching rather than replacing teaching, it is stated that the prerequisite for successful gamification can be achieved with effective teaching content. (Landers 2014). Moreover, in gamification theory, it is reported that another purpose of gamification is to directly affect behavior and attitudes related to learning. It is argued that these behaviors and attitudes affect the relationship between instructional content and learning outcomes. In addition, this theory assumes that gamification has an indirect positive effect on learning outcomes. (Landers 2014).

In the literature, it is seen that many studies have been conducted on the effectiveness of gamification in terms of learning processes. In these studies (Muntean, 2011; Hakulinen at al., 2015) it is emphasized that gamification in teaching increases motivation and participation in the lesson. Moreover, it has been suggested that the use of gamification can be effective in providing desired behaviors in education and helping students achieve their intended learning outcomes (Lee & Hammer, 2011; Simões at al., 2013). In addition, it is conveyed in the findings of some studies (Domínguez at al., 2013; Lee & Hammer, 2011) that gamification has many cognitive, affective and social benefits. In the study conducted at Indiana University in Bloomington in 2010 on gamification, it is reported that gamification is effective in learning processes and the average grade is higher than the previous year (Laster, 2010). Although there is a significant increase in students' motivation with the inclusion of gamification in the learning process

(Domínguez at al., 2013), it is stated in some studies that applications that are insufficient to attract students' attention and that do not attract attention are insufficient to create a positive effect in terms of learning outcomes (Stott & Neustaedter, 2013). In the researches, mixed findings have been reached with studies showing results both in favor and against gamification. (Buckley & Doyle, 2016; Mekler at al., 2017; Sailer at al., 2017).

Due to the mixed findings in the literature on gamification in education, it is seen that many meta-analysis studies (Yıldırım & Şen, 2019; Sailer & Homner, 2020; Bai at al., 2020; Karakoç at al., 2020) have been conducted. Meta-analysis studies are frequently used to evaluate the strength of available evidence on a topic in the literature. In Yıldırım and Şen's (2019) meta-analysis, it was determined that gamification has a moderately positive effect on students' academic achievement. In addition, in the research, the courses in which gamification was made were handled in two categories as the technology and the non-technology group, and the effect on academic achievement was examined. In the results of the research, it was determined that gamification did not have a significant effect on academic achievement in technology-based courses, while gamification made a significant difference in academic achievement in non-technology-based courses. Moreover, in the study, it was determined that gamification according to school level had a significant effect on academic achievement. In the meta-analysis study conducted by Bai at al. (2020), it was determined that gamification has a moderately positive effect on academic achievement, similar to previous meta-analyses. In the study, sample size, course, intervention time and whether financial rewards are provided or not were examined as moderators. The findings show that sample size and intervention time are significant moderators in terms of academic achievement. Finally, a large level of effect size was found in the meta-analysis study conducted by Karakoç at al. (2020). In the study, it was determined that the effect of gamification in education on students' academic success did not differ significantly according to school level, different reporting types and various disciplines.

1.2. Purpose of the research

In the literature, when the previous meta-analyses examining the effect of gamification on academic achievement were examined, it was determined that different effect sizes were reached. There may be many reasons for the variation of the detected effect sizes. It appears that a number of moderators have been examined in previous meta-analysis studies to identify possible causes of these effect size differences. Apart from the moderators discussed in meta-analysis studies, it is possible that cultural differences also affect academic achievement. In this direction, while examining the effect of gamification on academic achievement in the current research, the effect of different moderators will be examined, apart from the moderators discussed in the previous meta-analysis. In

addition, the current study, it was aimed to examine the effect of gamification on academic achievement by including only studies in Turkey in the meta-analysis. In line with the above-mentioned situations, answers were sought for the following problems:

1. What is the common effect size of gamification on academic success according to the results obtained from experimental studies conducted in Turkey between 2010-2020?
2. Does the common effect size of gamification on academic achievement differ significantly according to publication years, class sizes, school subjects in which games were used, student' levels and kinds of games?

This study, which seeks answers to two basic research questions, can make a unique contribution to the literature in terms of the effect of gamification on academic achievement, including only studies in Turkey and, unlike previous meta-analysis studies, a series of moderators.

2. Method

The research was carried out according to the meta-analysis method, one of the quantitative research methods. In this method, it is aimed to reach the overall effect size by combining the effect size of independent studies on a specific subject in the literature. (Bayraktar, 2020). In this study, independent studies in the literature examining the effect of gamification on academic achievement were included in the meta-analysis process. In addition, analyzes were made for some moderators in terms of the effect of gamification on academic achievement.

2.1. Moderating variables in the study

In the current study, some moderator variables that are thought to affect the overall effect size were examined. These; student' levels (Middle school, high school and university), kinds of games (digital and non-digital games), school subjects in which games were used (Information technologies, Science, Mathematics, Social studies, Turkish and Foreign language), publication year and class sizes (number of learners).

2.2. Literature search procedure

Within the scope of the research, some databases were used in order to access studies examining the effect of gamification on academic achievement in Turkey. In this context, the databases of "Web of Science", "ERIC (EBSCO)", "Scopus (A&I)", "Google Scholar", "ULAKBIM" and National Thesis Center were searched. In order to reach the researches, the keywords "gamification", "the effect of gamification on academic achievement" and

"gamification and academic achievement" were used in the databases. The databases were searched for studies conducted between 2010 and 2020.

2.3. Inclusion and exclusion criteria

In meta-analysis studies, some criteria are predetermined for the studies to be included in the study. The criteria sought in the studies included in the meta-analysis in the current study are as follows:

- To be conducted in Turkey between the years of 2010 and 2020,
- To be published in either Higher Education Thesis Center or peer-reviewed journals,
- To include sufficient amount of statistical information (sample size and mean, standard deviation),
- To examine the effect of the teaching approach under investigation on student achievement through experimental methodology with experimental and control groups
- To be examined the effect of gamification on academic achievement,
- To be an academic paper published in Turkish or English.

Studies excluded from the meta-analysis study; These are the theses that are not within the research boundaries and cannot be accessed due to lack of access permission, studies with qualitative data and all studies that do not have sufficient data for analysis. In addition, if the studies of the same author and the subject were published as both an article and a thesis, only one of them was included in the meta-analysis.

In line with the above criteria, the titles and summaries of the researches determined as a result of the scanning in the databases were examined. In addition, the methods and findings of the studies that were considered appropriate to be included in the research were examined and evaluated. The PRISMA flowchart (Moher at al., 2009) showing the process of literature review of the studies included in the meta-analysis is presented in Figure 1.

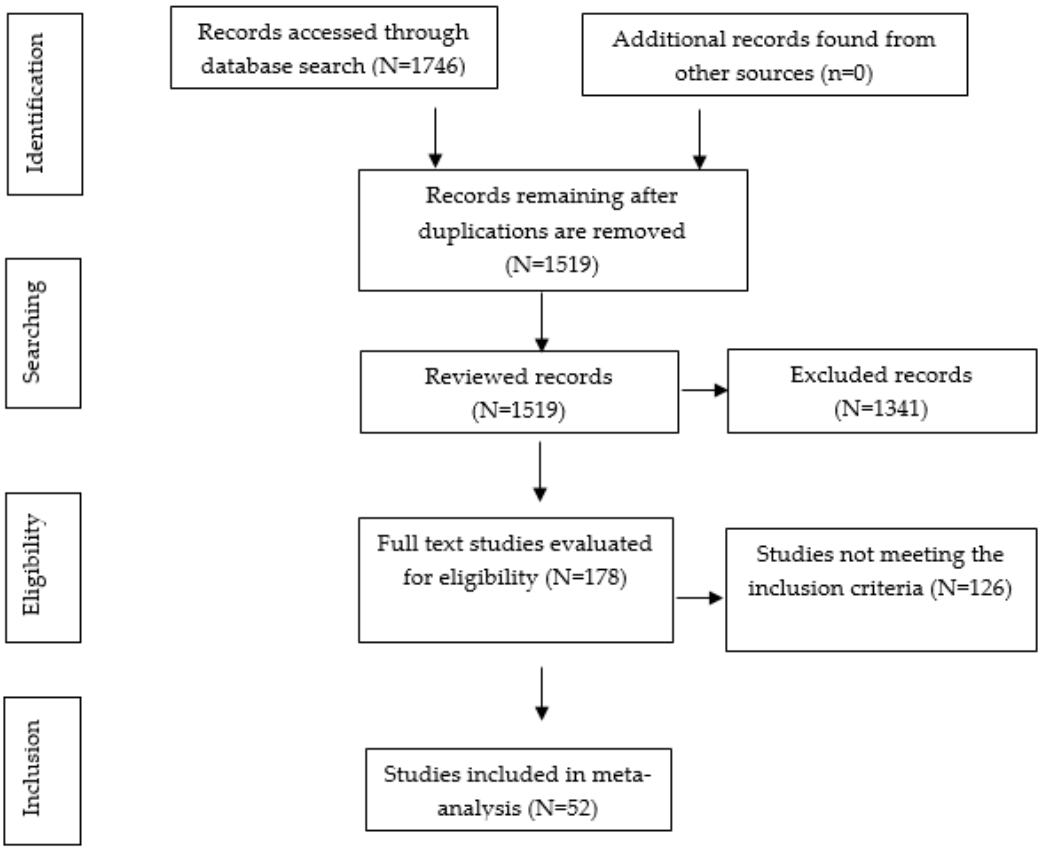

Figure 1. Flow chart for selection of studies

As seen in the PRISMA flowchart, 1746 studies were reached as a result of the first search in databases in order to determine the effect of gamification on academic success. After examining the studies, it was determined that 227 of them were duplicates. In addition, as the title and content of 1341 studies were found to be irrelevant, it was decided to exclude them from the research. As a result, 178 studies remained. When these studies were examined within the scope of inclusion criteria, 126 were eliminated. In this context, it was decided to include 52 studies that met all the criteria in the meta-analysis.

2.4. 2.4. Data Coding

The coding process has an important place in meta-analysis studies. Care should be taken to ensure that the data included in the analysis do not show erroneous results. This is important for the reliability of the research. In this context, a coding form suitable for the purpose of the research was created in order to compare the characteristics of the studies included in the current study. The coding form consists of three parts: the identity of the study, the content of the study, and the data of the study. The identity of

the research shows the number, title, year of publication, and type of publication of the research. The content of the study includes the course, education level, type of gamification, year of publication, and sample size. The data of the study include the number of participants, standard deviation, and mean. Two different researchers entered the coding form independently. Coders are experienced enough to participate in the coding process, as they have Ph.D. degree in educational sciences and have many qualitative studies. Miles and Huberman's (1994) formula was used to find the percentage match of data researchers, which the researchers coded independently. The consistency level of the researchers' codes was found to be 98%. This value is interpreted as showing that there is a perfect fit between the encoders (Viera & Garret, 2005).

2.5. 2.5. Data Analysis and Interpretation

There are three different models in meta-analysis studies: random effect, fixed effect, and mixed effect. Which effect model should be used in studies depends on some criteria. In the fixed-effect model, it is assumed that the studies included in the meta-analysis are homogeneous. Differences in the effect size of this model are considered to be due to sampling errors. In the random effect model, it is stated that the studies are heterogeneous, the differences in effect sizes may be due to sampling errors, and the characteristics of the sample in the studies included in the meta-analysis (Cooper, 2010). In addition, the mixed-effects model assumes that differences in effect size are due to sampling errors, between-study differences, and random elements (Borenstein, Hedges, Higgins & Rothstein, 2010). Researchers examine the heterogeneity between the data while deciding which model to use (Bakioğlu & Göktaş, 2018). In the current meta-analysis, heterogeneity was calculated (Table 4), and it was determined that it would be appropriate to use the random effects model in line with the findings. In the current meta-analysis, ANOVA analysis was used to compare categorical moderators and meta-regression analysis was used to examine continuous moderators. If a moderator level had a sample size of less than two, it was excluded from the analysis. The CMA 2.0 program was used to obtain the graphics and calculate the effect sizes in the current meta-analysis study. Cohen's (1988) and Thalheimer and Cook's (2002) classifications are widely used in the literature to comment on the calculated effect size values during the meta-analysis application process. In the current meta-analysis, "Cohen's d" was taken into account in calculating the effect size. According to Cohen (1988), an effect size between .20 and .49 indicates a small level effect, a medium effect between .50 and .79, and a large effect if it is greater than .80. A value of .05 was accepted as a reference in interpreting the findings of the study as statistically significant. Another important situation in the interpretation of meta-analysis studies is publication bias. In studies using the meta-analysis method, giving priority to statistically significant studies and not including studies that are not statistically significant causes publication bias (Borenstein, Cooper, Hedges, & Valentine, 2009). Some analyzes are performed to

determine whether there is publication bias in meta-analysis studies. In the current study, "Funnel Plot" and "Rosenthal fail-safe number (FSN) value" were used to examine publication bias.

3. Results

This section describes the findings of the meta-analysis. In this direction, firstly, descriptive information about the meta-analysis is given. Then, the calculated effect size values and the changes in the sub-category groups were examined.

3.1. Descriptive Results of the Studies

Definitions examined in the current research; coded under publication year, education level, and type of gamification. Descriptive statistics of these variables are presented in Table 1.

Table 1. Descriptive results of the eligible studies

Variables	**Frequency (f)**	**Percentage (%)**
Publication Years		
2010/2011	1/2	1.92/3.85
2012/2014	2/2	3.85/3.85
2015/2016	2/8	3.85/15.39
2017/2018	8/11	15.39/21.15
2019/2020	7/9	13.46/17.31
Student' levels		
Middle school	6	11.54
High school	39	75
University	7	13.46
Kinds of games		
Digital	16	30.77
Non-digital	36	69.23

According to the results, it was observed that the studies included in the meta-analysis were conducted in 2010 at the most, while at least in 2020. In addition, the sample group was mainly university students. While non-digital games were used in 16 of the studies, digital games were used in 36 studies. In terms of kind of games, the studies generally focused on academic achievement. The studies were mainly conducted in Turkey. It was determined that the number of samples reached within the scope of 52 studies was 2911.

3.2. The Reliability of the Study

A number of methods are recommended to ensure reliability in meta-analysis studies. In meta-analysis studies, considering only published and meaningful studies raises the issue of publication bias. In order to determine possible publication bias, funnel plot was drawn, and Rosenthal fail-safe number (FSN) value was calculated. The funnel plot was provided in Figure 3. The funnel plot was provided in Figure 2.

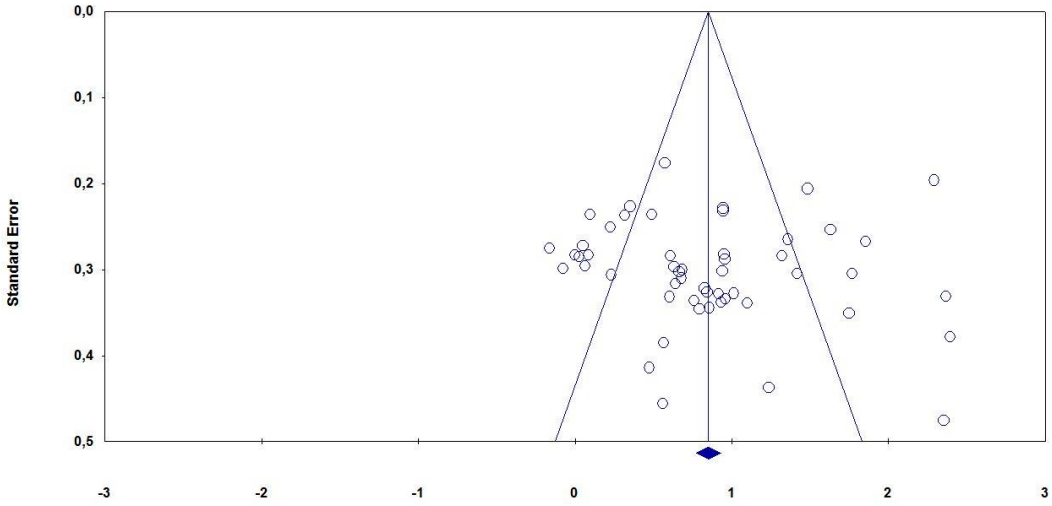

Figure 2. The funnel plot

As seen in the figure, the funnel plot does not present an asymmetric funnel, revealing that the eligible studies do not have publication bias. In order to ensure the absence of publication bias, Rosenthal fail-safe number (FSN) value was calculated. The results are provided in Table 2.

Table 2. Rosenthal's Fail-Safe Number Calculations

Z-value for observed studies	21.17583
p-value for observed studies	0.00000*
Alpha	0.05000
Tails	2
Z for alpha	1.95996
Number of observed studies	52
Fail-safe *N*	6.018

As seen in Table 2, the FSN was calculated as N = 21.176. According to Rosenthal, a high N number will increase the validity of the results obtained with the meta-analysis (Borenstein at al., 2009). Moreover, this value is well above the N/5k+10 (N: Number of Error Protection; k: Number of studies included in the meta-analysis) limit and is too high to reach (Mullen at al., 2001). This information was accepted as another indication

that there was no publication bias and that the results of the meta-analysis were reliable (Rosenthal, 1991).

3.3. Findings of General Effect Size

The studies examining the effect of gamifaction on academic achivement were gathered by using the random effect model. The results are provided in Table 3.

Table 3. Overall effect size, heterogeneity, and confidence intervals

			% 95 confidence interval				Null Test		Heterogeneity	
Model	N	Effect Size	Standard Error	Variance	Lower Limit	Upper Limit	Z Value	P Value	Q Value	p
Random	52	.862	. 092	.008	.682	1.043	9.377	.000	266.417	.000

The heterogeneity test produced a signifincant result (Qmodel=266.417, p= .000). The overall effect size was found to be .86, which is a large effect size as suggested by Cohen (1977). Therefore, it may be concluded that there was a large and positive association between gamification and academic achievement. In addition, gamification in teaching explains 74% of the total variance of academic achievement. The forest plow showing the studies' effect sizes and confidence intervals is provided in Figure 3.

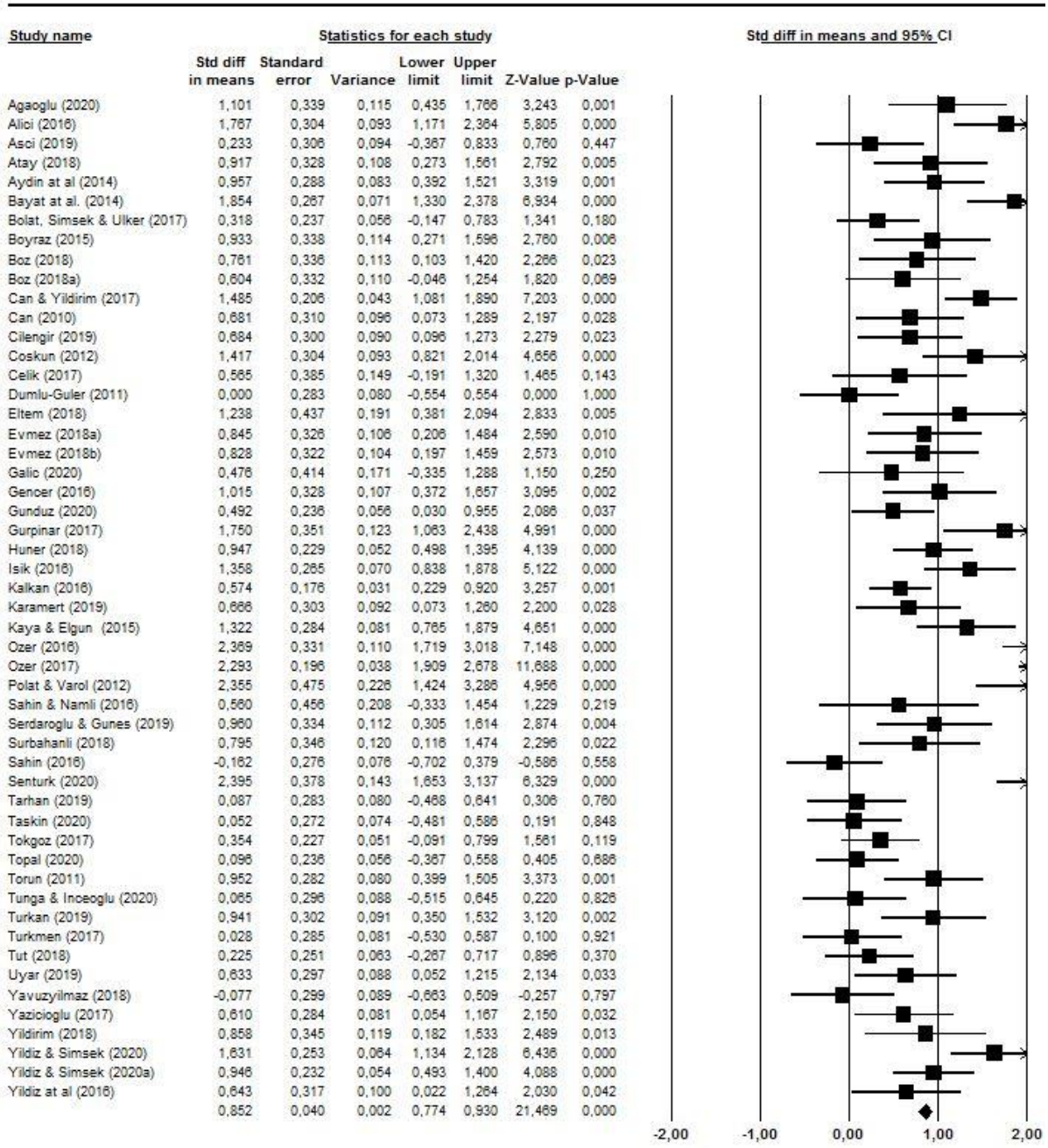

Figure 3. The forest plow of random effects estimates for the included studies

The black figures shown in the forest plot provide information about the effect size of the individual study. The right and left extensions show the lower and upper limits of the 95% confidence interval.

3.4. Results of Moderator Analysis

There is a variation in the student' levels, course/subject, class sizes, and kinds of games variables among the studies. Thus, the effects of those variables on studies' effect sizes were examined in order to determine their moderating effects. The findings are presented in Table 4.

Table 4. The effect sizes of studies on including moderators in relation to academic achievement

Moderators	Variables	Number of studies	Effect Size	Standard error	95% Confidence Interval		Qb	sd	p
					Lower Limit	Upper Limit			
Student' levels	Middle school	6	1.0409	.3623	.3309	1.7510	.703	2	.704
	High school	39	.8636	.0966	.6744	1.0529			
	University	7	.6830	.2619	.1697	1.1963			
	Total	52	.854	.088	.681	1.026			
Course/Subject	Computer & information	7	.630	.285	.071	1.189	13.261	5	.021*
	Science	29	.993	.131	.736	1.250			
	Mathematics	4	.416	.162	.099	.734			
	Social Studies	3	1.314	.406	.518	2.110			
	Language	2	.479	.264	-.038	.996			
	Foreign Language	4	1.014	.148	.723	1.305			
	Total	49	.816	.076	.667	.964			
Kind of games	Digital	16	.604	.154	.303	.905	3.982	1	.046*
	Non-digital	36	.976	.105	.770	1.182			
	Total	52	.857	.087	.687	1.027			
Class sizes	<20	9	.887	.227	.443	.1.331	4.448	2	.108
	20-40	8	.756	.107	.546	.965			
	>40	35	1.56	.212	.840	1.672			
	Total	52	.861	.088	.689	1.034			

*p< .05

According to the findings in Table 4, student' levels did not have a significant moderator effect in terms of the effect of gamification on academic achievement. (Qb = .703, p> .05). In addition, it has been determined that the course in which gamification is used is an important moderator in the effect of gamification on academic achievement (Qb = .13.261, p< .05). Accordingly, the highest effect size was observed in the Science course (d= .993) and the lowest effect size was observed in the Mathematics course (d= .416). In addition, in the research, it was determined that kind of games was a significant moderator in the effect of gamification on academic achievement (Qb = 3.982, p< .05). The findings showed that non-digital games (d= .976) increased academic achievement more than digital games (d= .604). Moreover, it was determined that the effect of gamification

on academic achievement did not differ significantly according to the class sizes (Qb = 4.448, p> .05)

In meta-analysis studies, while categorical moderators are analyzed using the analog to the analysis of variance (ANOVA), continuous moderators are examined using multi-regression analysis. Since the publication year variable was a continuous variable, meta-regression analysis was performed. The findings are presented in Figure 4.

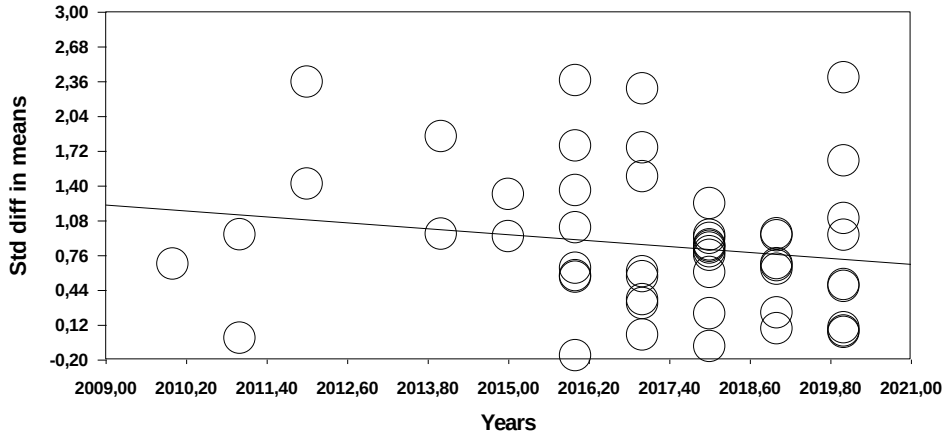

Figure 4. The Association between Publication Year and Effect Size

As seen in Figure 5, it is seen that there was a negative increase in the line slope as the publication year progressed from the past to the present. Table 6 provides the statistical results for this decrease.

Table 5. The statistical results for the publication year variable and the effect sizes

	Point Estimation	Standard Error	Lower Limit	Upper Limit	Z value	p-value
Slope	98.7927	74.2755	-46.7846	244.3700	1.33	.1835
Intercept	-.0485	.0368	-.1207	.0236	-1.32	.1873

As seen in Table 5, it can be said that the publication years of the studies were conducted were not significant moderators in terms of the effect of gamification on academic achievement (p<.05).

4. Discussion

The present study aims to reveal the effect of gamification in education on academic achievement by using the meta-analysis method. In this context, 52 studies examining the effect of gamification on academic achievement in Turkey were included in the meta-analysis. Due to the heterogeneity between the effect size values in the current study, the random effect model was used and the average effect size value was determined as 0.862. These results show that gamification has a large positive effect on students' academic

achievement (Cohen, 1988). In addition, it was determined that gamification explained 74% of the variance in the academic achievement of students. Coe (2002) argued that a small and inexpensive change that could increase academic achievement in education with an effect size as small as 0.1 would be a very important development. In this respect, the results of the current meta-analysis show that gamification has a significant positive effect on students' learning performance. In the literature, it is stated that gamification has a positive effect on academic achievement in many respects. Gamification encourages goal setting among students. Goal setting can direct the individual's attention to goal-related activities and increase retention in learning (Locke & Latham, 2002). Moreover, gamification can meet a student's recognition needs. Recognition can be a source of pride, and increased pride can lead to continued engagement and better learning in course assignments (Landers at al., 2015). In addition, gamification provides feedback on the student's individual performance and the performance of their peers (Bai at al., 2020). In this context, the positive effect of gamification on learning in the literature strengthens the results of the current meta-analysis. The results of summary impact analysis in the current research were similar to those from meta-analyses conducted in the context of gamification (Tokaç at al., 2019; Toraman at al., 2018; Yıldırım & Şen 2019; Karakoç at al., 2020). However, it is seen that the effect sizes obtained in some meta-analysis studies are different from the findings of the current research. (Baptista & Oliveira, 2019; Bai, 2020; Huang at al., 2020). There may be two different reasons for this situation. The first is that the studies included in the meta-analysis studies, which are compatible with the findings of the current study, were conducted only in Turkey. It is seen that the effect size in meta-analysis studies examining the effect of gamification on academic achievement in Turkey is at a large level. It is seen that meta-analysis studies conducted in different countries also determined a medium effect size. This result may be the reason for cultural differences in terms of gamification of learning. In support of the findings of the current research, it is reported that culture has an effect on gamification in the research conducted by Stathopoulou (2019). In addition, the second reason for the difference between the findings in the meta-analysis may be publication bias in the meta-analysis studies (Cohen, 1992). A series of analyses were conducted to assess publication bias in the present study. The results obtained from the funnel plot with the Rosenthal fail-safe number (FSN) value show that there is no publication bias (Duval & Tweedie, 2000). Accordingly, it can be said that the findings of the present study are reliable.

In the present study, some analyzes were made for a number of moderators who were thought to be important in terms of the effect of gamification on academic achievement. The first of these moderators is the student' levels. In previous meta-analyses (Bai at al., 2020), it is stated that it is important to examine student' levels as a moderator in terms of the effect of gamification on academic achievement. The findings of the current research show that student' levels is not a significant moderator in terms of the effect of

gamification on academic achievement. It is seen that the meta-analysis studies in the literature (Tokaç at al., 2018; Yıldırım & Şen, 2019; Karakoç at al., 2020) have similar findings. In this context, it can be said that gamification is not limited to a certain age period, but can be used in all student' levels.

Another moderator examined within the scope of the research is the school subjects in which games were used. The findings show that the effect of gamification on academic achievement differs significantly in terms of the school subjects in which games were used. While it was determined that gamification was more effective on academic achievement in the social studies course, it was determined that it had the least effect on the academic success of the mathematics course. The results of previous meta-analysis studies seem to be inconsistent with the results of the present study. It is thought that one of the reasons for this situation may be due to the fact that the courses were grouped as technology-based and non-technology-based in previous meta-analyses (Yıldırım & Şen, 2019; Bai et al., 2020). In addition, a limited number of subject disciplines appear to have been included in previous meta-analyses. These may account for the differences in findings between the current study and previous meta-analysis studies. In this context, it can be said that gamification does not have a similar effect on academic achievement for all subject disciplines. In addition, it is thought that the subject covered in the courses where gamification is made may be effective in terms of the effect size on academic achievement.

Another moderator considered in the current meta-analysis is the kinds of games. The results of the research show that non-digital games are more effective on academic achievement than digital games. Studies (Gregory at al., 2015) show that digital games are not a "magic bullet" for education. In addition, it is reported that it is not right to place a digital game in the classroom and wait for students to learn or to solve behavior management and motivation problems. It can be said that in digital games, cognitive skills are used more intensively than psychomotor skills. Moreover, it is very difficult to design elements that can activate effective structures in digital games. In addition to all these, non-digital games allow the use of cognitive, affective, and psychomotor skills together. This may be a reason for higher academic achievement in non-digital games compared to digital games. In addition, due to the nature of gamification, it should create motivating and satisfying experiences and provide a permanent change in the behavior of individuals (Koivisto & Hamari 2019). In this context, it can be said that creating some experiences in digital games may be more difficult than in non-digital games.

In the research, the years of the publications were examined as moderators in order to examine whether there is a significant difference according to the years in terms of the effect of gamification on academic achievement. Findings show that the effect of gamification on academic achievement does not differ significantly according to publication year. Studies (Guardia at al., 2019; Tsay et al., 2018; Diaz-Ramirez, 2020)

have reported that students value gamification positively and that it can be more effective than traditional methods in terms of developing skills such as teamwork, hands-on training, verbal communication skills, the ability to learn in new situations and generate new ideas. The results obtained in this context show that gamification is still an effective structure in terms of the learning process.

In this study, it was determined that the class sizes were not a significant moderator in the effect of gamification on academic achievement. This shows that gamification can be effective in all classroom environments. Contrary to the findings of the current research, a larger effect size was found in small sample groups in the meta-analysis study conducted by Bai (2020). The fact that the effect size gets smaller as the sample gets larger is related to publication bias. It is reported that the effect size of studies with large samples should be higher (Schäfer & Schwarz, 2019). In this respect, it is important to examine the bias on the results of the studies to be included in the meta-analysis studies. The findings of the current meta-analysis are that there is no publication bias (see Table 3). In this context, it can be said that the sample size is not an important moderator in terms of the effect of gamification on academic achievement. However, it was seen that there were 23 subjects in the study with the smallest class sizes in the studies included in the current meta-analysis, while the study with the largest class sizes had 94 subjects. In this context, it can be said that the results of the current study are limited to the class sizes of the studies included in the meta-analysis.

4.1. Limitations and Directions for Future Research

The current research has some limitations. The first of these is the student' levels. It is seen that the studies included in the current meta-analysis were conducted at middle school, high school, and university levels. In terms of the effect of gamification on academic achievement, no studies were found at the primary school level. Moreover, it can be said that limited studies have been carried out at the middle and high school levels. More experimental studies are needed at different student' levels to clearly determine the effect of gamification on academic achievement. Another limitation of the research is related to the courses reviewed as moderators. Another limitation of the research is related to the courses in which the games used. In the current meta-analysis, it was determined that the courses in which games were used was a significant moderator in terms of the effect of gamification on academic achievement. However, it was determined that there are limited studies for some courses. Moreover, the existence of a study on the physical education course made it impossible to examine this course as a moderator. In this direction, there is a need for studies to be conducted in different courses in terms of the effect of gamification on academic achievement. Future research can examine the effect of gamification on academic achievement in different courses. Another limitation of the current research is the cultural influence on the research

findings. Only studies from Turkey were included in the current meta-analysis. Future research may examine the impact of gamification on academic achievement in different countries. The last limitation of the current study is that the studies to be included in the meta-analysis do not contain sufficient statistical data. The lack of sufficient statistics in some studies prevented their inclusion in the current meta-analysis. As it is known, meta-analysis studies are fed from the studies in the literature. For this reason, it is important that future researches take care to present statistical results comprehensively.

5. Conclusion

The present study aimed to determine the common effect size by combining the findings of studies examining the effect of gamification on academic achievement in Turkey with the meta-analysis method. In general, it was determined that gamification had a large and positive effect on academic achievement. In addition, it was found that gamification positively predicted the variance of academic achievement. The findings showed that gamification is an effective variable on academic achievement. It was seen that the school level was not statistically significant in terms of moderator variables examined in the current study. In this direction, it can be said that it would be appropriate to use gamification at all educational levels. Moreover, it was determined that the effect of gamification on academic achievement differed statistically significantly according to the course type. Therefore, similar results may not be obtained in different courses. In addition, physical games were found to have more positive effects on academic achievement than digital games. In this context, more use of physical games may be effective in increasing academic success. Additionally, as a result of the present study, it was determined that the effect of gamification on academic achievement did not differ significantly by years. Finally, the findings of the current study showed that the effect of gamification on academic achievement did not differ significantly according to the sample size moderator. This shows that gamification can be used in crowded classrooms. As a result, it can be said that gamification significantly increases the success of students.

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