ERJournal
Education Reform Journal Volume 7 Number 1, 2022
http://dx.doi.org/10.5281/zenodo.6826451
e-ISSN: 2602-3997

The Effect of Gamification on Learner Motivation: A Meta-Analysis Study

Ibrahim YILDIRIM[1] Sevilay CIRAK-KURT[2]

Submitted: March 8, 2021; Accepted: May 15, 2022; Published Online: June 30, 2022

Abstract

Plenty of research has been carried out in order to determine the effect of gamification on learner motivation. The purpose of this study was to combine the experimental research results examining the effect of gamification on learner motivation and conducted between the years of 2010-2017 through a meta-analysis. The random effects model was used in the study and the mean value for the effect size was estimated using Hedges' *g* (0.54). The obtained Hedges' *g* value corresponds to the moderate level of effect. Within the scope of the present study, the sub-group analyses for the type of publication, the country where the research was conducted and the number of elements used in the design were also performed and it was determined that the effect size did not differ significantly according to the relevant sub-groups.

Keywords: Gamification, meta-analysis, learner motivation, game elements.

Introduction

The term motivation, defined to be the driving force that prompts the individual into action for a particular purpose and ensures the continuity of behaviour (Ryan & Deci, 2000), stems from the Latin origin of "movere" with the meanings of moving and mobilising. Being regarded as the key to learning and achievement, motivation has been explained through a number of theories such as social cognitive theory, self-determination theory, achievement-goal orientation, and is grouped into intrinsic motivation, extrinsic motivation and non-motivation (Deci & Ryan, 1985). Although plenty of research has been done on what motivates people, it is almost impossible to draw a general framework in that there are many psychological factors motivating the individuals in addition to the different bases and the processes for each individual. While internal bases are more effective on the motivation of some people, the external stimuli are more useful for the others. However, it is clear that intrinsic or extrinsic motivation is more powerful together rather than alone. A well-motivated individual is even willing to do the hard work.

The method of problem solving faced by Ross Smith offers a convenient model to concretize the case. The software of Microsoft Windows and Office which are used around the world and in many languages are constantly improving and renewing themselves. For each new release, the software needs to be thoroughly examined for all languages which is a very annoying, difficult and time-consuming task.

[1] Corresponding author: Gaziantep University, [0000-0002-4137-2025], iyildirim84@gmail.com
[2] Adiyaman University, [0000-0001-8951-8727], sevilaycirak@hotmail.com

Smith faced with the problem of controlling the dialog boxes for different languages when Windows 7 was first developed. It is clearly comprehensible how challenging the problem was when considering Windows 7 had more than half a million of dialog boxes and all should be checked for the whole languages. In search for a solution to the problem, Smith decided to gamify the process through the structure he called "Language Quality Game(LQG)". LQG created an environment with competitive dynamics for the participants. During the game, the participants would review the boxes, report errors, and rise in the leaderboard through earning points. More than half a million dialogs were examined by 4500 participants in short time and around 6700 errors were reported. The participants made great effort to win the game not only for themselves but also for the dignity of their own language (Werbach & Hunter, 2012). The process operated by Ross Smith is basically called gamification and the effect of this design on motivation is undeniable through making a specific task more enjoyable. As can be understood, the concept of gamification is defined as the use of game design in non-game areas (Deterding et.al., 2011). The design, generally known as game design, consists of three main elements: dynamics, mechanics and components. The dynamics that can be regarded as the mystery structure of the system are the framework that determine the concept at utmost level. They provide integrity and consistency and consist of elements that are not so easy to describe, such as constraints in design, emotions, narration and progression structure. Mechanics are the elements that provide and regulate movement. Chance, competition, cooperation and challenges are among the mechanics in game design. While dynamics and mechanics describe how the system works, components represent the output of the system. Game design components can generally be listed as points, badges, levels, experience points (xp) and leaderboards (Bunchball, 2010; Werbach, 2014).

The gamification design has many working areas from tourism to health, from shopping habits to city planning and its successful integration into the learning environment can be called as the gamification of education. The gamification of education can be exemplified with the use of the aforementioned game components such as points, badges and levels in educational environments through blending with game dynamics and mechanics. Many studies have been carried out to test the effects of the use of gamification in educational settings on achievement, engagement and attitude towards the lesson and they revealed the positive effects of gamification (Bell, 2014; Denny, 2013; Dominguez et.al., 2013; Foster, Sheridan, Irish, & Frost, 2012; Lee &Hammer, 2011; Measles & Abu-Dawood, 2015; Rouse, 2013; Toda et.al., 2014; Wongso, Rosmansyah, & Bandung, 2014; Wood & Reiners, 2012; Yildirim, 2016). Gamification design contributes to the learner motivation not only during the course but also in every single learning process. To illustrate, Toda et.al. (2014) mentions the positive contribution of gamification to the contestant motivation upon the students preparing for Mathematical Olympiad.

The increase in primary research on gamification has led the researchers to investigate the effects of gamification from a broader perspective, and many studies have been conducted on the compilation of gamification (de Sousa Borges, Durelli, Reis & Isotani, 2014; Dicheva. Dichev, Agre & Angelova, 2015; Garland, 2015; Hamari, Koivisto & Sarsa, 2014; Mora, Riera, González & Arnedo-Moreno, 2015). It was observed that different theoretical frameworks (Deterding, 2011; Ryan & Deci, 2000) were used in the studies for "motivation" (e.g. Nicholson, 2012) in which gamification was studied to a great extent and even the concept of motivation was defined through it and primary studies on the subject were quite many. Among these research, some argued that the gamification design increased the learning motivation (Rouse, 2013; Toda et.al., 2014), while the ones claiming that this structure was nothing but a nonsense (e.g. Bogost, 2011; Chorney, 2012; Robertson, 2010; Todd, 2017) or reporting no effect on motivation (Polat, 2014). There are many studies on the effect of gamification on motivation and it is determined that different results have been obtained. In this regard, the following questions were sought in the present study conducted to combine the results of experimental studies examining the effect of gamification on learner motivation between 2010-2017 through meta-analysis.

1. What is the effect of the gamification of education on learner motivation?
2. Is the effect size of the gamification of education on learner motivation valid?
3. Does the effect of the gamification of education on learner motivation differ by the type of academic publication (WoS, other index, thesis)?

4. Does the effect of the gamification of education on learner motivation differ by the country where the research was conducted (USA, Europe, other)?

5. Does the effect of the gamification of education on learner motivation differ by the number of elements used in the gamification design?

The study is significant in terms of revealing the effects of gamification design on learner motivation. It also examines the effect on motivation in terms of different cultures or the number of elements used (while single element is used in some studies, the others include more than one element, and some others have been carried out with full gamification design). This study is also substantial in terms of demonstrating the overall picture through systematically compiling and synthesizing the studies examining the effects of gamification on motivation, and thus guiding the researchers and practitioners who will apply the gamification design.

Research Method

The increase in the number of primary studies on a specific subject and the emergence of different results lead to the necessity to find a common ground. Borenstein, Hedges, Higgins, and Rothstein (2009) defined meta-analysis as the endeavor of systematically combining the results of quantitative studies. In this study, meta-analysis method was used as it was attempted to bring together the results of quantitative studies systematically. For the meta-analysis process, Moher et al.'s (2009) PRISMA guidelines were followed.

Data Sources and Search Strategy

Within the scope of the research, Google Academic and Web of Science databases were searched in order to reach the proceeding papers and theses in addition to the articles. During the searching procedure of Google Academic database, the keyword patterns as follows:

"intitle:gamification OR intitle:gamify" "education" "experimental OR empirical" "motivation"

When searching the Web of Science database, the following keywords were chosen:

"Title:Gamification" AND "Topic: Motivation" AND "Years: 2010-2017"

It was aimed to reach all the studies in English language. The searching procedure in line with the purpose of the study was completed in May, 2018 and the studies in the 8-years period between 2010 and 2017 were covered.

Inclusion and Exclusion Criteria

The inclusion criteria of the studies have been determined as;

1. Being published between the years of 2010 – 2017,

2. Being a thesis or an article written in English language, (the reasons of excluding the proceeding papers will be explained in the following section)

3. Investigating the effect of gamification on learner motivation through experimental methods,

4. To provide sufficient statistical information to estimate the effect size.

According to the final search conducted in May 2018, a total of 1554 studies have been reached, 1254 of which from Google Scholar and 300 of which from Web of Science. These studies were subjected to a pre-assessment and 325 of them were chosen to be examined in detail. Finally, a total of 22 studies were included in the study in conformity with the inclusion - exclusion criteria. A total of 27 effect sizes were obtained due to the fact that some of the 22 studies involved more than one experimental process and different experimental groups. As a result of the meta-analyses performed with 27 distinct effect sizes, it was revealed that there was a serious publication bias problem related to the validity of the obtained value. First of all, significant deviations from the symmetrical structure were observed according

to the examination of the funnel plot. The classic fail safe N value for the data consisting of 27 effect sizes was estimated to be 114 at .05 confidence level. All these findings referred to the publication bias.

When the analysis of publication bias was deepened, it was observed that the challenge was originated from the proceeding papers. Cooper, Hedges, and Valentine (2009) express that the studies with relatively low quality of publication lead to publication bias and they can be readily eliminated to determine the effect size in a more valid way. In this regard, the meta-analysis was carried out with 18 effect sizes obtained from the remaining 16 studies by excluding the proceeding papers.

Demographic and Publication Characteristics

The descriptive data of the experimental studies included in the meta-analysis and examining the effect of gamification on learner motivation were presented in Table 1.

Table 1. Descriptive information of the included research

	Publication	Pub. type	Country	Elements	N
1	Barrio, 2016	Wos	Europe	2 or more elements	131
2	Brühlmann, 2015	Thesis	Europe	1 element	76
3	Fitz-Walter, 2015	Thesis	Other	2 or more elements	46
4	Fitz-Walter, 2016	Wos	Other	2 or more elements	50
5	Hanus, 2015	Wos	USA	2 or more elements	142
6	Hong, 2014	Other index	Other	2 or more elements	60
7	Hsu, 2016a	Thesis	USA	2 or more elements	59
8	Hsu, 2016b	Thesis	USA	2 or more elements	60
9	Hudiburg, 2016	Thesis	USA	2 or more elements	30
10	Johnson, 2017	Thesis	USA	2 or more elements	30
11	Ketyi, 2016	Wos	Europe	2 or more elements	64
12	Kim, 2017	Wos	USA	1 element	104
13	Lieberoth, 2014a	Wos	Europe	1 element	45
14	Lieberoth, 2014b	Wos	Europe	1 element	48
15	Rouse, 2013	Thesis	USA	1 element	58
16	Serpe, 2017	Thesis	USA	2 or more elements	30
17	Stansbury, 2017	Wos	USA	2 or more elements	93
18	Yapici, 2017	Other index	Other	2 or more elements	30

In Table 1, the publication types are identified as Web of Science (SCI, SCI-Exp, SSCI, and AHCI), other indexes and thesis (master thesis or doctoral dissertation) when the descriptive information of the research is given. While the countries where the research was conducted have been listed as USA, Europe and other countries, the design title is grouped into the studies using many elements or a single element. It can be seen that the studies included in the meta-analysis were mostly conducted in the USA, benefit from the combination of different gamification elements and comprised a total of 1156 learners as the participants.

Coding Procedures and Sub-groups

In order to obtain correct findings in meta-analysis studies, it should be ensured that the data is coded correctly (Lipsey & Wilson, 2001). In this respect, all data were coded separately by two distinct researchers and full compatibility was observed between the codes.

There are 18 effect sizes obtained from 16 studies within the study. In this research, the data also collected about sub-groups to identify the situations in which the effect size may vary besides estimating the overall effect size. Therefore, publication years, types of publications, country where the research was conducted, design pattern and the statistical information given were reported in relation to the included studies. Within the scope of sub-group analysis; the differences by the type of publication (WoS, Other index, thesis), the country where the research was conducted (USA, Europe, Other Countries), and the number of elements used in the gamification design (1 element, 2 or more elements) were examined.

Statistical Analysis

In data analysis, what should be decided first is the transformation of the values obtained from different studies according to a specific standard score. The values gathered from difference-based research may be used through converting into Cohen's *d*, Hedges' *g* and Glass Δ effect size values (Borenstein et.al., 2009). In this study, the values obtained from studies were analysed after their conversion into to Hedges' *g* value. The interpretation of the effect sizes was made according to Cohen's (1988) criteria. The criteria indicated small, medium and large effect sizes with .2, .5 and .8, respectively. Furthermore, Q statistics and I^2 values were examined to determine the heterogeneity of the studies. I^2 values indicate low, moderate and high level of heterogenity with 25, 50 and 75 percents, respectively (Higgins & Thompson, 2002). Sub-group analyses were also conducted with the grouping variables.

Validity, Reliability and Publication Bias

The validity of mean effect size estimates obtained from the data analysis is of great importance. The most potential threat to validity is publication bias. With this purpose in mind, publication bias was tested (Rothstein, Sutton, & Borenstein, 2005). In order to determine the validity, the funnel plot was tested with the Duval and Tweedie trim-and-fill method (Duval, & Tweedie; 2000). The researches included in the study demonstrated by hollow circles in the funnel plot. The closed discs also represent fictitious researches that must be included in the study to ensure that no publication bias emerges at all. According to the funnel plot, the hollow circles should be symmetrical on right-left sides in order to avoid publication bias. Rosenthal's (1979) "fail safe N" value was also tested.

The reliability of the research procedure was ensured by means of searching processes and effect size calculations made by two different researchers separately and the comparisons of findings. There was an agreement between two researchers in all these steps.

Results

This section presents the findings of the overall effect size, the validity of effect size estimates and the sub-group analyses respectively.

The results of the overall effect size

Table 2 shows the heterogeneity tests and the effect sizes results in fixed and random effects models obtained by the combination of research results.

Table 2. The Hedges' *g* values and the test of heterogeneity

Model	*n*	ES	*Z*	SE	%95 CI		df	*Q*	*p*	I^2
					Lower limit	Upper limit				
Fixed	18	0.449	7.529	0.060	0.332	0.556	17	50.57	0.00	66.38
Random	18	0.538	5.045	0.107	0.329	0.747				

The effect size for the data of the studies included in the meta-analysis was estimated to be 0.45 based on fixed effect model with the 95% confidence interval of 0.33-0.56. Also, the effect size was estimated to be 0.54 according to the random effects model with the 95% confidence interval of 0.33-0.75. The heterogeneity of the included studies in meta-analysis was tested (Borenstein et al., 2009). At this context, the $Q(_{df=17})$ statistic was estimated to be 50.57 ($p < .01$). The obtained Q value indicated the heterogeneity of the data. Besides, I^2 value estimated was 66.38% which imply heterogeneity, as well.

The random effects model was used as the researchers assumed that the estimated differences between the learner motivations in the studies included in the meta-analysis differed beyond the sampling error. The estimated 0.54 Hedges' *g* value corresponds to a moderate level of positive effect according to Cohen (1988). The forest plot showing the distribution of the effect sizes according to random effects model was given in Figure 1.

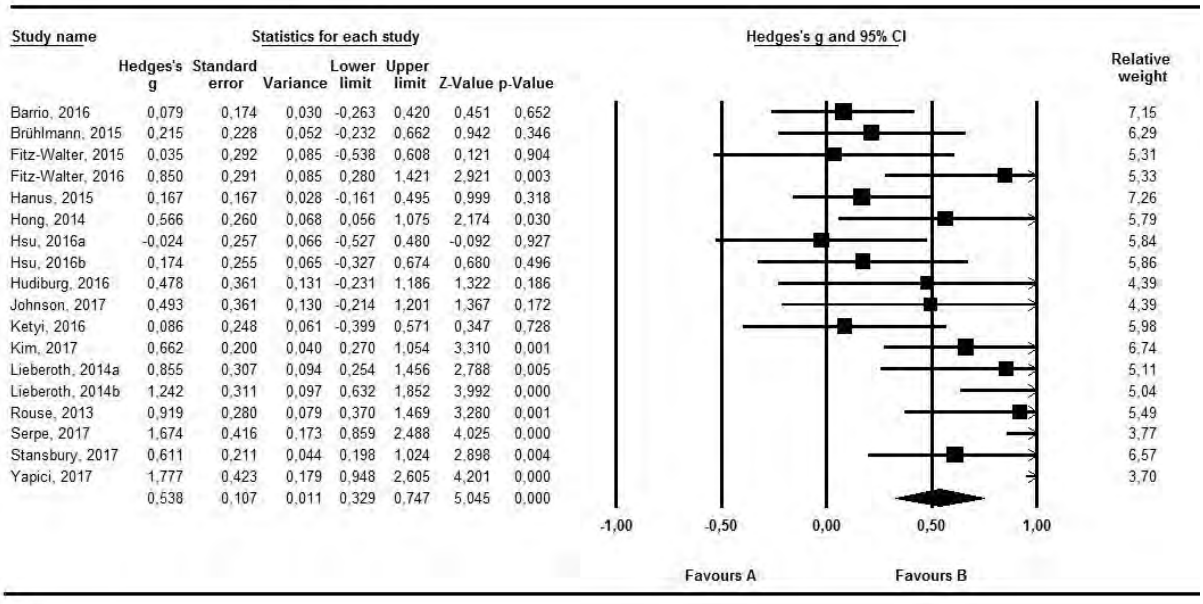

Figure 1. Forest Plot Showing the Distribution of the Effect Size of the Studies

According to the forest plot shown in Figure 1, the highest effect on the estimated mean effect size is the study of Hanus and Fox (2015), while the lowest effect belongs to the research of Yapici and

Karakoyun (2017). In addition, the values of the effect sizes confirm the results that the effect is in positive manner as 17 of them are positive while one solely is negative.

The results of the validity of effect size estimates

The mean effect size estimates obtained as a result of the research should reflect the facts. The most potential threat to the reality, namely validity, is publication bias. Therefore, the funnel plot submitted in Figure 2 was examined by Duval and Tweedie (2000) trim-and-fill method to investigate whether the obtained effect size fit for purpose as stated by Rothstein, Sutton, and Borenstein (2005).

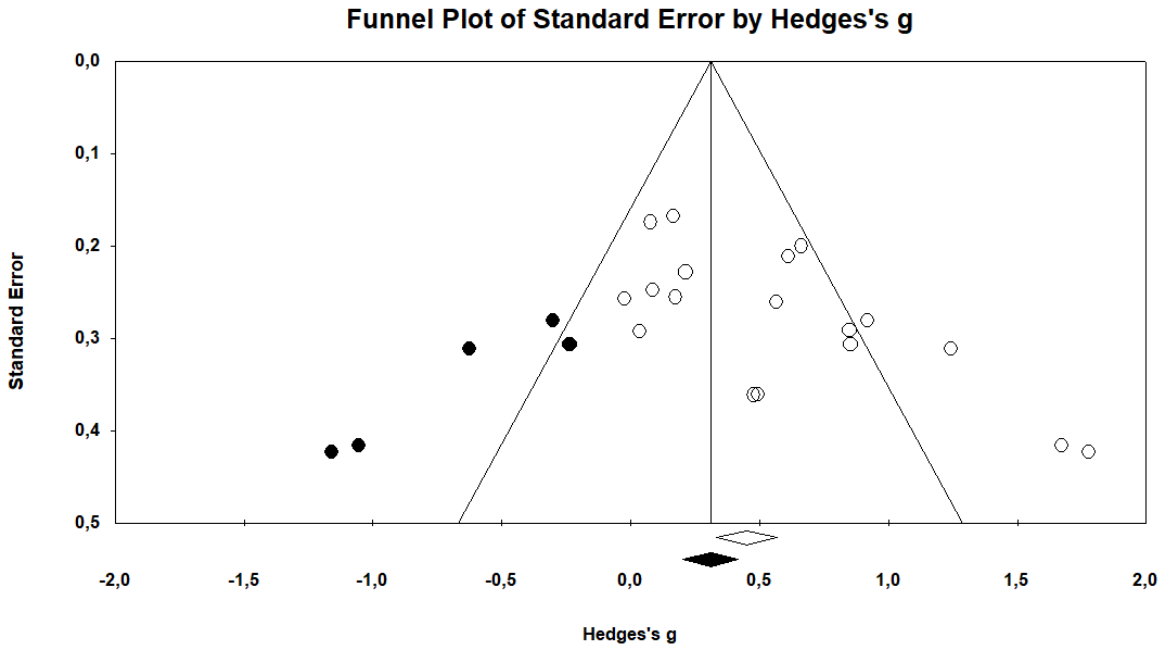

Figure 2. Funnel Plot

It can be said that the funnel plot drawn for the researches in this study is symmetrical. According to Duval and Tweedie's (2000) trim-and-fill method, the number of fictitious studies that must be added in order to avoid publication bias is five. This indicates that there is no publication bias. Moreover, Rosenthal's (1979) "fail safe N" number was also calculated for assessment of publication bias (Rothstein, Sutton, & Borenstein, 2005). The number of fail-safe N was calculated as 315 at .05 confidence level. This means that at least 315 studies with opposite results must be found in the literature to invalidate the results of this meta-analysis. The number of 315 is more than three times the value of 100 obtained by the formula 5k + 10 (k=18) (Fragkos, Tsagris, & Frangos, 2014). This finding also reveals that the results are valid.

The results of the sub-group analyses

Besides the overall effect size analysis, sub-group analysis was conducted to determine in which the heterogeneity of the findings originated from.

• In the sub-group analysis, it was first examined whether the type of publication causes a statistically significant difference. The results of analog to ANOVA on whether the effect of gamification

on learner motivation differed by the type of publication based on random effects model were presented in Table 3.

Table 3. Differences in Effect Size by Publication Type in Random Effects Model

Group	*n*	ES	SE	% 95 CI Lower limit	% 95 CI Upper limit	df	Q_B	*p*
WoS	8	0.521	0.141	0.245	0.796	2	1.216	0.545
Other index	2	1.125	0.604	-0.058	2.309			
Thesis	8	0.439	0.171	0.104	0.774			
Overall	18	0.508	0.107	0.298	0.717			

The fact that the heterogeneity value of the sub-groups belonged to publication types (Q_B=1.216, $p > .05$) is smaller than the chi-square critical value of 5.99 indicates that there aren't statistically significant differences among the groups. In other words, the effect of gamification on learner motivation is similar in different types of publications.

• In the sub-group analysis, it was secondarily tested whether the country where the research was conducted causes a statistically significant difference. The results of analog to ANOVA on whether the effect of gamification on learner motivation differed by the country of research based on random effects model were given in Table 4.

Table 4. Differences in Effect Size by the Country of Research in Random Effects Model

Group	*n*	ES	SE	% 95 CI Lower limit	% 95 CI Upper limit	df	Q_B	*p*
USA	9	0.514	0.139	0.242	0.786	2	0.677	0.713
Europe	5	0.449	0.212	0.034	0.863			
Other	4	0.753	0.310	0.145	1.361			
Overall	18	0.526	0.109	0.313	0.739			

The fact that the heterogeneity value of the sub-groups (Q_B=0.677, $p > .05$) is smaller than the chi-square critical value of 5.99 indicates that there aren't statistically significant differences among the groups. In other words, the effect of gamification on learner motivation is similar and moderate level in different countries.

• In the sub-group analysis, it was finally examined whether the number of elements used in gamification design causes a statistically significant difference. The results of analog to ANOVA on whether the effect of gamification on learner motivation differed by the number of elements used in its design based on random effects model were shown in Table 5.

Table 5. Differences in Effect Size by the Number of Elements Used in Random Effects Model

Group	*n*	ES	SE	% 95 CI Lower limit	% 95 CI Upper limit	df	Q_B	*p*
1 element	5	0.739	0.169	0.407	1.070	1	1.831	0.176
2 or more elements	13	0.453	0.126	0.205	0.701			
Overall	18	0.556	0.101	0.357	0.754			

The fact that the heterogeneity value of the sub-groups (Q_B=1.831, p > .05) is smaller than the chi-square critical value of 3.84 implies that there aren't statistically significant differences between the groups. In other words, the effect of gamification on learner motivation does not differ by the number of elements used. That is, the use of single element or multiple elements has a similar and moderate level effects on motivation.

Conclusion and Discussion

The gamification of education was previously defined as the integration of the game design including dynamics, mechanics and components into the educational environments. There has been a great number of experimental research on whether the game design equivalently motivates the individual when playing game in educational settings. In the present study, the effects of gamification on learner motivation were attempted to reveal through combining the results of the aforementioned experimental studies. In this regard, a total of 27 effect sizes were obtained from articles, dissertations and the proceeding papers. The results of the meta-analyses performed with 27 effect sizes indicated that there was serious publication bias with regard to the validity of the obtained value. As the investigations on the available data were deepened, it was concluded that the publication bias was largely stemmed from the proceeding papers, and they were excluded as offered by Cooper, Hedges, and Valentine (2009). After the exclusion of the proceeding papers, the meta-analysis was operated with 18 effect sizes from the remaining 16 studies. According to the research results obtained from 18 experimental studies with 1156 learners, it was determined that gamification had a moderate level positive effect on learner motivation (ES=0.54). The sub-group analyses were performed considering that the effect in question could be differentiated by certain sub-groups. As a result, it was ascertained that the obtained effect size did not differ in terms of the type of publication (WoS, Other index, thesis), the country where the research was conducted (USA, Europe, Other Countries), and the number of elements used in the gamification design (1 element, 2 or more elements). The findings of the study were limited to the findings of scientific papers and theses assessed as part of systematic literature review. The present study is substantial in terms of contributing to the literature in terms of statistically identifying the overall effect of gamification on learner motivation.

It is emphasized that education reforms are needed in order to draw attention to the use of technologies that will increase the effectiveness of distance learning as a result of the fact that distance learning has become mandatory in all education levels especially with the global pandemic period and this process is completely mediated by digital technologies (TEDMEM, 2020). To put it more clearly, it is expected that technology-oriented education reforms will be realized in the near future. According to the TIMSS (2019) report, it is seen that teachers' rate of using digital technologies that support teaching and learning are related to student success (Kelly, Centurino, Martin, & Mullis, 2020). The present research is important in terms of compiling the experimental results in the literature on gamification, which mediates the increase of learner motivation, which is one of the important components of distance learning regarding the reforms expected to be carried out. Quizizz, Kahoot!, Socrative are just a few of the many gamification apps with extremely easy to use, user-friendly interfaces.

To begin with, the shortage of primary studies reached with regard to the research criteria can be regarded as the indication of the necessity of further experimental research with statistical information as stated by Dicheva et.al. (2015). The moderate level positive effect of the gamification design on learner motivation exhibits the effectiveness of gamification design. Meta-analysis studies conducted in the related literature also contain similar results. For example, in a meta-analysis study in which 18 primary studies were included conducted by Kim and Castelli (2021), the motivation in gamified environments was determined through variables such as participation level and the overall effect size (Cohen's *d*) was found as 0.48. Zhang, Yu, and Yu (2021) also conducted a meta-analysis study in which they compiled

the effect of gamification on achievement and motivation. This study also indicates that gamification could enhance learner achievement (Cohen's d=0.62) and motivation (Cohen's d=0.61). The present validates the individual experimental research demonstrating that gamification increases motivation through interviews, attendance statistics and etc. (Buckley & Doyle, 2016) and the results obtained from the compilation of studies in the literature (Hamari, Koivisto & Sarsa, 2014), and it also confirms the discourse of "increasing motivation" within the definitions of gamification (Dicheva, Dichev, Agre & Angelova, 2015). It suggests that gamification can be used in learning environments considering that motivation is crucial to create desirable outcomes.

The sub-group analysis results proving that the aforementioned effect did not differ by the type of publication and the country of research can be seen as the evidence for the prevalence of this kind of impact. This finding supports the proposition that gamification should be used to increase motivation over again. The effect of gamification on learner motivation was found to be similar according to the examination by different types of publication. While, it corresponds to the moderate level of effect for the publications of Web of Science and thesis, the high level of effect was observed in the publications of other index. The research included eight Web of Science, eight theses and two other index primary research. It can be asserted that the effect of gamification on motivation in the sub-group of other index publication type was found to be relatively higher as the reliability of the results may have been affected by the difference among the primary research numbers (Ayaz & Soylemez, 2015).

On the other hand, the use of one or more elements in gamification design or the application of the full gamification yields similar effect. This finding is in agreement with the results of the relevant literature (Mekler, Brühlmann, Opwis, & Tuch 2013). In their research, Mekler et.al. (2013) concluded that the groups of points, meaningful framing and the combination of the two had a similar effect on motivation. From this point of view, it can be claimed that even a single element is sufficient to increase learner motivation in a purposeful design involving the dynamics and mechanics of gamification. Considering that achievement and the desirable learning outcomes are fundamental and that motivation has a positive relationship with achievement, it is advisable to use gamification elements as much as possible. Moreover, we can conclude that it is possible to start with a single element and the others can be integrated during the ongoing process since one or more elements in true gamification design has been found to produce similar effect as a result of the meta-analysis.

The positive effect of gamification on motivation has been ascertained as the common result of different studies which make us infer that gamification can be used effectively to support learner motivation and gamification design will gain importance in the era of digitalization.

Conflicts of interest

No potential conflict of interest was reported by the authors.

Availability of data and material

The datasets used and/or analyzed during the current study are available in the article.

Acknowledgements

None. No funding to declare.

References

Note: References with asterisk (*) indicate studies included to meta-analysis.

Ayaz, M. F., & Soylemez, M. (2015). The effect of the project-based learning approach on the academic achievements of the students in science classes in Turkey: A Meta-Analysis Study. *Education and Science, 178*, 255-283.

*Barrio, C. M., Muñoz-Organero, M., & Soriano, J. S. (2016). Can gamification improve the benefits of student response systems in learning? An experimental study. *IEEE Transactions on Emerging Topics in Computing, 4*(3), 429-438.

Bell, K. R. (2014). *Online 3.0---the rise of the gamer educator the potential role of gamification in online education* (Order No. 3635727). Available from ProQuest Dissertations & Theses Global. (1615085697). Retrieved from http://search.proquest.com/docview/1615085697?accountid=15958

Bogost, I. (2011). Why gamification is bullshit. In S. P. Walz & S. Deterding (Eds.), *The gameful world: Approaches, issues, applications* (pp.65-80). London, England: The MIT Press.

Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2009). *Introduction to meta-analysis.* Hoboken, NJ: Wiley.

*Brühlmann, F. (2015). *The Effects of Framing in Gamification: A Study of Failure*. Unpublished Master Thesis. University of Basel, Switzerland.

Buckley, P., & Doyle, E. (2016) Gamification and student motivation. *Interactive Learning Environments, 24*(6), 1162-1175. Doi: 10.1080/10494820.2014.964263.

Bunchball, Inc (2010). *Gamification 101: An introduction to the use of game dynamics to influence behavior.* White paper.

Chorney, A. I. (2012). Taking the game out of gamification. *Dalhousie Journal of Interdisciplinary Management*, 8(1), 1-14.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences (2. edition).* Hillsdale, NJ: Lawrence Earlbaum Associates.

Cooper, H., Hedges, L. V., & Valentine, J. C. (2009). *The handbook of research synthesis and metaanalysis (2nd edition)*. New York, NY: Russell Sage Publication.

de Sousa Borges, S., Durelli, V. H., Reis, H. M., & Isotani, S. (2014). A systematic mapping on gamification applied to education. *SAC'14* (pp. 217-222). ACM.

Deci, E., & Ryan, R. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press.

Denny, P. (2013). *The effect of virtual achievement son student engagement*. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. Presented at CHI13'. ACM, pp.763–772.

Deterding, S. (2011). *Situated motivational affordances of game elements: a conceptual model*. In:Gamification: Using Game Design Elements in Non-Gaming Contexts, a Workshop at CHI. Presented atCHI2011. ACM, Vancouver, BC, pp. 1–4.

Deterding, S., Dixon, D., Khaled, R. & Nacke. L. (2011). From game design elements to gamefulness: defining "gamification". In Proceedings of the *15th International Academic MindTrek Conference: Envisioning Future Media Environments (MindTrek '11)*. ACM, New York, NY, USA, 9-15. DOI=10.1145/2181037.2181040.

Dicheva, D., Dichev, C., Agre, G., & Angelova, G. (2015). Gamificatio in education: A Systematic mapping study. *Educational Technology & Society, 18*(3), 75-88.

Domínguez, A., Saenz-De-Navarrete, J., De-Marcos, L., Fernández-Sanz, L., PagéS, C., & Martínez-HerráIz, J. J. (2013). Gamifying learning experiences: Practical implications and outcomes. *Computers & Education,* 63, 380-392.

Domínguez, A., Saenz-de-Navarrete,J., de-Marcos,L., Fernández-Sanz,L., Pagés,C., & Martínez-Herráiz, J.-J. (2013). Gamifying learning experiences: practical implications and outcomes. *Computers & Education,63*, 380–392. http://dx.doi.org/10.1016/j. compedu.2012.12.020.

Duval, S., & Tweedie, R. (2000). Trim and fill: a simple funnel-plot–based method of testing and adjusting for publication bias in meta-analysis. *Biometrics, 56*(2), 455–463.

*Fitz-Walter, Z. J. (2015). *Achievement unlocked: Investigating the design of effective gamification experiences for mobile applications and devices*. Doctoral dissertation, Queensland University of Technology.

*Fitz-Walter, Z., Johnson, D., Wyeth, P., Tjondronegoro, D., & Scott-Parker, B. (2016). Driven to drive? Investigating the effect of gamification on learner driver behavior, perceived motivation and user experience. *Computers in Human Behavior, 71*, 586-595.

Foster,J.A., Sheridan,P.K., Irish,R., & Frost,G.S. (2012). *Gamification as a strategy for promoting deeper investigation in a reverse engineering activity*. In:Proceedings of the 2012 American Society for Engineering Education Conference, pp. AC2012–AC 5456.

Fragkos, K. C., Tsagris, M., & Frangos, C. C. (2014). Publication bias in meta-analysis: confidence intervals for Rosenthal's fail-safe number. International scholarly research notices, 2014.

Garland, C. M. (2015). Gamification and implications for second language education: A Meta Analysis. Unpublished Master Thesis. Graduate Faculty of St. Cloud State University.

Hamari, J., Koivisto, J., & Sarsa, H. (2014). *Does gamification work?– A literature review of empirical studies on gamification.* Proceedings of the 47th Hawaii International Conference on System Sciences, Hawaii, USA, January 6–9.

*Hanus, M. D., & Fox, J. (2015). Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. *Computers & Education, 80*, 152-161.

Higgins, J., & Thompson, S. G. (2002). Quantifying heterogeneity in a meta-analysis. *Statistics in medicine*, *21*(11), 1539-1558.

*Hong, G. Y., & Masood, M. (2014). Effects of gamification on lower secondary school students' motivation and engagement. *International Journal of Social, Education, Economics and Management Engineering, 8*(12), 3483-3490.

*Hsu, K. C. (2016). *Social Gamification in Multimedia Instruction: Assessing the Effects of Animation, Reward Strategies, and Social Interactions on Learners Motivation and Academic Performance in Online Settings*. Doctoral dissertation, University of Kansas, USA.

*Hudiburg, M.L. (2016). *Motivation and Learning in an Online Collaborative Project Using Gamification*. STEMPS Theses & Dissertations. Paper 5.

*Johnson, D. L. (2017). *Motivational Effects of Badging from Gamification Theory in Asynchronous Discussion Forums Within Graduate Blended Education*. Doctoral dissertation, Lancaster Bible College, USA.

Kelly, D.L., Centurino, V.A.S., Martin, M.O. ve Mullis, I.V.S. (2020). TIMSS 2019 encyclopedia: Education policy and curriculum in mathematics and science. Retrieved from https://timssandpirls.bc.edu/timss2019/encyclopedia/

*Ketyi, A. (2016). From mobile language learning to gamification: an overlook of research results with business management students over a five-year period. *Porta Linguarum. Revista Internacional de Didáctica de las Lenguas Extranjeras*, I, 45-60.

Kim, J., & Castelli D. M. (2021). Effects of gamification on behavioral change in education: a meta-analysis. *International Journal of Environmental Research and Public Health, 18*(7), 1-13. https://doi.org/10.3390/ijerph18073550.

*Kim, K., & Ahn, S. J. G. (2017). The role of gamification in enhancing intrinsic motivation to use a loyalty program. *Journal of Interactive Marketing, 40*(C), 41-51.

Lee, J. J. ve Hammer, J. (2011). Gamification in Education: What, How, Why Bother? *Academic Exchange. Quarterly*, 15(2). ss.1-5.

*Lieberoth, A. (2015). Shallow gamification: Testing psychological effects of framing an activity as a game. *Games and Culture, 10*(3), 229-248.

Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis*. Thousand Oaks, CA: Sage.

Measles, S. ve Abu-Dawood, S. (2015). Gamification: Game–Based Methods and Strategies to Increase Engagement and Motivation within an eLearning Environment. *In Society for Information Technology & Teacher Education International Conference* (Vol. 2015, No. 1, pp. 8319-8324).

Mekler, E. D., Brühlmann, F., Opwis, K., & Tuch, A. N. (2013). *Disassembling gamification: the effects of points and meaning on user motivation and performance*. Paper presented at the CHI'13 extended abstracts on human factors in computing systems.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & Prisma Group. (2009). *Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement.* PLoS med, 6(7).

Mora, A., Riera, D., González, & Arnedo-Moreno, J. (2015). A literature review of gamification design frameworks. *2015 7th International Conference on Games and Virtual Worlds for Serious Applications (VS-Games)* (pp. 1-8). IEEE.

Nicholson, S., (2012). *A user-centered theoretical framework for meaningful gamification*. In:Proceedings of Games Learning Society 8.0.Madison,WI.

Robertson, M. (2010). *Can't Play, Won't Play*. Retrieved March 20, 2017 from http://kotaku.com/5686393/cant-play-wont-play

Rosenthal, R. (1979). The "file drawer problem" and tolerance for null results. *Psychological Bulletin, 86*, 638–641.

Rothstein, H. R., Sutton, A. J., & Borenstein, M. (Eds.). (2005). *Publication bias in meta-analysis: Prevention, assessment and adjustments*. West Sussex: John Wiley ve Sons.

*Rouse, K. E. (2013). *Gamification in science education: The relationship of educational games to motivation and achievement* (Order No. 3569748). Available from ProQuest Dissertations & Theses Global. (1370800410). Retrieved from http://search.proquest.com/docview/1370800410?accountid=15958

Ryan, R.M., & Deci, E.L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American psychologist, 55*(1), 68-78.

*Serpe, R. L. (2017). *Gamification Through Algebraic Coding.* Master Thesis, College at Brockport, State University of New York, USA.

*Stansbury, J. A., & Earnest, D. R. (2017). Meaningful gamification in an industrial/organizational psychology course. *Teaching of Psychology, 44*(1), 38-45.

TEDMEM. (2020). Covid-19 Sürecinde Eğitim: Uzaktan Öğrenme, Sorunlar ve Çözüm Önerileri 2020. Retrieved from https://tedmem.org/

Toda, A. M., Do Carmo, R. S., Silva, A. L. ve Brancher, J. D. (2014). Project SIGMA-An Online tool to aid students in Math lessons with gamification concepts. Retrieved December 12, 2015 from http://www.jcc2014.ucm.cl/jornadas/EVENTOS/SCCC%202014/SCCC-9.pdf

Todd, A. (2017). Why Gamification is Malarkey. *The Morning Watch: Educational and Social Analysis*, 44(1-2).

Werbach, K. & Hunter, D. (2012). *For the Win. How game thinking can revolutionize your business.* Philadelphia, PA: Wharton Digital Press.

Werbach, K. (2014). *Gamification course*. Retrieved February 25, 2015 from https://www.coursera.org/course/gamification

Wongso, O., Rosmansyah, Y. ve Bandung, Y. (2014). Gamification Framework Model, Based on Social Engagement in E-Learning 2.0. *2nd International Conference on Technology, Informatics, Management, Engineering & Environment*. Bandung, Indonesia, August 19-21, 2014.

Wood, L. C. ve Reiners T. (2012) Gamification in logistics and supply chain education: Extending active learning. *IADIS Internet Technologies and Society, Perth (Australia)*, November 28-30, 2012, pp. 101-108.

*Yapici, İ. Ü., & Karakoyun, F. (2017). Gamification in biology teaching: A sample of Kahoot application. *Turkish Online Journal of Qualitative Inquiry, 8(*4).

Yildirim, I. (2016). *Development, implementation and evaluation of a gamification based curriculum for the lesson of "Teaching Principles and Methods"*. Unpublished Doctoral Dissertation. Department of Educational Sciences, Gaziantep University, Turkey.

Zhang, Q., Yu, L., & Yu, Z. (2021). A content analysis and meta-analysis on the effects of classcraft on gamification learning experiences in terms of learning achievement and motivation. *Education Research International*. https://doi.org/10.1155/2021/9429112.