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Gamification and serious games: A literature meta-analysis and integrative model

Abstract

In recent years we have witnessed a growing number of companies and institutions embedding game mechanics and game design techniques in all types of information systems, applications, and services. Following this trend, it is possible to find an increasing number of publications studying these subjects. With this meta-analysis we synthesise and integrate all the earlier literature and information available on gamification and serious games, assessing the current state-of-the-art in the field, filling a literature gap on this subject. We calculated meta-analysis effects from a total of 54 studies and 59 datasets collected from the literature. Attitude, enjoyment, and usefulness are the most relevant predictors of intention to use gamification. Intention, enjoyment, and usefulness are the most relevant predictors of the brand attitude towards gamification. Our results allow us to present a theoretical model that will be of value to future gamification studies.

Keywords: gamification, serious games, meta-analysis.

1. Introduction

Gamification is considered one of the top software trends (Morschheuser et al., 2017) and it is present in our daily lives, although sometimes we do not even recognise it (Dias, 2017). Among several distinct definitions available in literature, we acknowledge gamification as the use of game-design elements in non-gaming contexts (Deterding et al., 2011), in a process of enhancing a service with game-related features that support users' overall value creation (Huotari & Hamari, 2017). Gamification seeks to unite functionality and engagement (Morschheuser et al., 2017), to increase usability (Saha et al., 2012), productivity, and satisfaction (Rajanen & Rajanen, 2017), to create more enjoyable

experiences (Liu & Santhanam, 2017), to drive behaviours (Rodrigues et al., 2014), and to produce positive business impact (Morschheuser et al., 2015).

The context of our study, the starting point, is the extensive range of often contradictory results present in information systems literature regarding gamification. Although garnering a substantial amount of research attention, gamification results and literature are still scattered, leaving a clear space for additional research to describe, synthesise and integrate all the information available, reducing the time needed to understand or to study this phenomenon within the literature.

Our primary research goal is to synthesise earlier gamification findings, identifying the most utilised factors mentioned in the literature and their significance, providing a balanced theoretical supporting model for future gamification studies. During recent years we have witnessed a growing number of gamification applications in multidisciplinary areas such as commerce (Bittner & Schipper, 2014), environment and ecological behaviour (Prestopnik & Tang, 2015), cartography (Kapenekakis & Chorianopoulos, 2017), machine learning (Dalmazzo & Ramirez, 2017), software development (Chow & Huang, 2017), innovation (Roth et al., 2015), health and medical issues (Fleming et al., 2017), politics (Santos et al., 2015), education (Kim et al., 2018), tourism (Saoud & Jung, 2018), finance and funding (Altmeyer et al., 2016), energy (Nicholson, 2012), mobility and transportation (Kazhamiakin et al., 2015), accessibility (Prandi et al., 2015), fashion (Insley & Nunan, 2014), usability (Rajanen & Rajanen, 2017), risk management (Bajdor & Dragolea, 2011), and marketing (Church & Iyer, 2018). We intend to complement earlier gamification literature reviews, such as Hamari et al. (2014), and earlier game oriented meta-analysis reviews, such as Hamari & Keronen (2017b), providing a straight utilitarian and instrumental perspective on the gamification phenomenon.

Earlier research suggests that meta-analysis is a better method than just a mere literature review (Hunter & Schmidt, 2014), that it is a rigorous and robust method (Zhang et al., 2012), that it is applicable even with conflicting results (Dennis et al., 2001), and that it helps to reinforce understanding and to provide a more concise view of gamification factors. For these reasons, it is the method employed in our work.

The paper is organised as follows. We start with the research methodology, in section two, followed by the meta-analysis description in section three, where we present the studies, variables, relationships, and results included in our work. We dedicate section four to the discussion of the results, and section five to describe the impact of our work on research and practice. We continue with the limitations, future research directions in section six, and we finish with the main conclusions, in section seven.

2. Research methodology

We undertook a systematic literature review during October and November 2017 to ensure that we have collected a list of pertinent works that is the most complete possible (Webster & Watson, 2002), with the most up-to-date research available in the area. We started identifying and searching in the most known electronic scientific databases available, namely ACM, IEEE, Science Direct, Scopus, Emerald, Springer, ISI Web of Science, Taylor & Francis, and Google Scholar. We searched these relevant sources continuously for gamification and interrelated keywords such as serious games, games for a purpose, productivity games, behavioural games, pervasive games, augmented reality games, as well as other grammatically equivalent terms such as gamified, gamify, gamifying, and gamif*. Following a rigorous inclusion criteria, the search was further limited to: (i) studies published or available online within the period between January 2010 and the end of January 2018, (ii) journals, articles, reviews, conferences, and books, allowing us to exclude most non-scientific publications, (iii) quantitative studies with complete correlation values, removing qualitative works, reviews, conceptual studies, or works that did not present this type of quantitative statistical information, and (iv) independent datasets, removing articles using previous datasets already included, and avoiding biasing the study using the sample more than once (Wood, 2008). Besides studies already published until the end of the literature review period, November 2017; we also included accepted papers in-press that had a publishing date until the end of January 2018 in our work.

Conferences, theses, and books were included in our work to address high effect sizes bias commonly linked with journal articles (Pappas & Williams, 2011). We did the same to the studies with multiple independent datasets (e.g. (Bourgonjon et al., 2013; Darban et al., 2016; Rodrigues et al., 2016a; Sande et al., 2015; Yang et al., 2017) each of them contributing with an additional dataset). The final result is a total of 54 papers and 59 datasets that meet the criteria, comprising 50 journal articles (92.6%), two conference papers (3.7%), one master dissertation (1.9%), and one book section (1.9%). This can be considered as a meta-analysis dimension comparable to other earlier studies published in top-tier Journals, such as Lamb et al. (2018), who included 46 studies, Wu & Lederer (2009), with 52, and Baptista & Oliveira (2016), with 57 works.

To visually represent the list of the most important gamification relationships found in the literature we used the IBM Watson Analytics online tool (available on https://www.ibm.com/watson-analytics). The meta-analysis results were obtained using the Comprehensive Meta-Analysis software tool (available on https://www.meta-analysis.com). Considering those relationships that were used three or more times in the literature, following Hamari & Keronen's (2017a) recommendations, we reduced the initial number to 21 relationships.

3. Meta-analysis

Meta-analysis provides a highly accurate method to calculate the factors influencing the use of a technology, allowing us to combine results from several works that share a similar subject (Hamari & Keronen, 2017b). This statistical method is considered the best approach to consolidate earlier research on gamification, superseding results from literature reviews that were not able to present consolidated results (Hunter & Schmidt, 2014). With it, both statistically significant and non-significant relationships found in the literature are analysed and contribute to the final results (Sabherwal et al., 2006), reinforcing the overall validity of the meta-analysis findings (Cook, 1991). Furthermore, analysing a body of literature such as the one before us enables seeing the gamification phenomenon from a broader perspective, not limited to the narrow scope of

individual works, creating the conditions to present more accurate and credible results (King & He, 2006).

In our meta-analysis we used a random-effects model following Hamari & Keronen's (2017b) approach, assuming that the true effect sizes vary from study to study (Borenstein et al., 2010). We acknowledge that the samples of the studies we used in our work may present different characteristics, differing in such divergent aspects such as age, gender, education, experience, income, health, or culture. The number of studies used in our work, 54, is considered adequate to provide good meta-analysis precision (Borenstein et al., 2010), and to allow overall results' generalisation (King & He, 2006).

3.1. Studies included in the work

As described in the methodology section, we conducted the literature search during October and November 2017. We compared all the works found against the defined inclusion criteria, allowing the identification and analysis of a total of 54 different studies that were published or were available online through the period of January 2010 up to the end of January 2018, as presented in **Table 1**.

Table 1 – Studies by Journal and year

Journal	2010 - 2012	2013	2014	2015	2016	2017	2018
Addictive Behaviors					(Boyle et al., 2017)		
Computers & Education	(Bourgonjon et al., 2010; Gomez et al., 2010)	(Bourgonjon et al., 2013; Hong et al., 2013)	(Sande et al., 2015)		(Buil et al., 2016; Darban et al., 2016; Hone & El Said, 2016)	(Buckley & Doyle, 2017)	
Computers in Human Behavior			(Koivisto & Hamari, 2014)	(Hamari et al., 2015; Hamari & Koivisto, 2015b; Mekler et al., 2015)	(Bachen et al. , 2016; Baek & Touati, 2016; Beard & Wickham, 2016; Bozanta et al., 2016; De-Marcos et al., 2016; Nelson, Verhagen, & Noordzij, 2016; Rodrigues et al., 2016b; Rodrigues et al., 2016a; Su et al., 2016)	(Çakıroğlu et al., 2017; Chen et al., 2017; Landers et al., 2017; Morschheuser et al., 2017; Oleksy & Wnuk, 2017; Rodrigues et al., 2017; Yang et al., 2017)	(Feng et al., 2018; Gan & Li, 2018; Macey & Hamari, 2018)
Electronic Commerce Research and Applications					(Hsiao & Tang, 2016; Rouibah et al., 2016)		
Information & Management	(Kong, et al. 2012; Turel et al., 2010)					(Sepehr & Head, 2017)	

Journal	2010 - 2012	2013	2014	2015	2016	2017	2018
Interdisciplinary Journal of E-learning and Learn. Objects			(Codish & Ravid, 2014)				
Intern. Journal of Child-Computer Interaction					(Tan et al., 2016)		
Intern. Journal of Information Management				(Hamari & Koivisto, 2015a)		(Chen et al., 2017)	
Intern. Journal of Hospitality Management					(Ozturk et al., 2016)		
Internet Research						(Baptista & Oliveira, 2017)	
Journal of Computer Information Systems					(Cheng et al., 2016)		
Journal of E-Learning and Knowledge Society						(Galbis-Córdova et al., 2017)	
Journal of Service Theory and Practice						(Mulcahy et al., 2017)	
Medical Informatics						(Lin et al., 2017)	
Telematics and Informatics						(Hsu et al., 2017)	
Tourism Management						(Liang et al., 2017)	
Book/ Book section				(Herzig et al., 2015)			
Conferences	(Herzig et al., 2012)					(Codish & Ravid, 2017)	
Dissertation					(Teensma, 2016)		
Total	**5**	**2**	**3**	**5**	**19**	**17**	**3**

The studies included in our work were undertaken in different countries, using different sample sizes, as summarised in **Figure 1**.

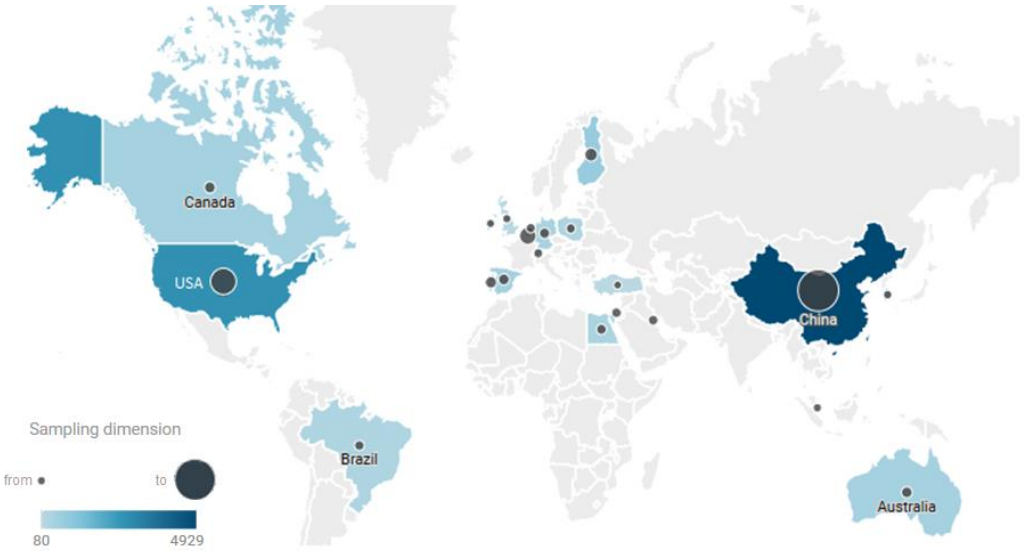

Figure 1 – Studies' world distribution and sample dimension

Of the 22 countries identified, China, the United States of America, and Belgium are the ones having the highest sum of respondents, respectively with 4929, 2741, and 1363, shared among five, twelve, and two different works.

Additional detail on the studies included in our work is presented in **Appendix A**, namely the technology being used, sample sizes, and the country of research for the 54 studies for which the meta-analysis has been performed.

3.2. Variables and relationships breakdown

From the literature review, for each study included in our work, we identified, aggregated, and ordered the list of variable relationships by dependent construct, assuming that a meta-analysis permits a numerical combination of relationships between two or more factors (Gerow et al., 2014). A total of 586 different and interrelated variable relationships were found. Intention was identified as the variable most used in gamification literature during the period analysed. The breakdown of this construct by independent variable is reported in **Figure 2.**

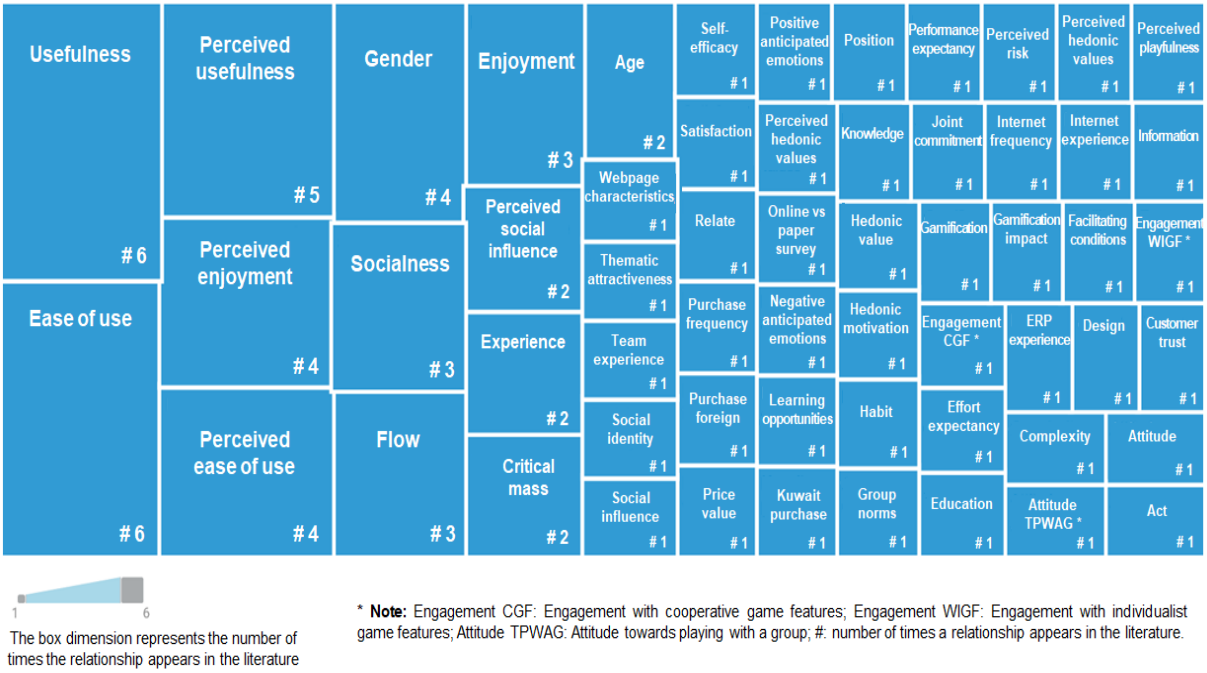

Figure 2 – Intention relationships breakdown

Some of the most important constructs, in terms of the number of appearances in the literature, are among others: attitude, brand attitude, continued use, enjoyment, and usefulness. The breakdown of these constructs is presented in **Fig. 3**.

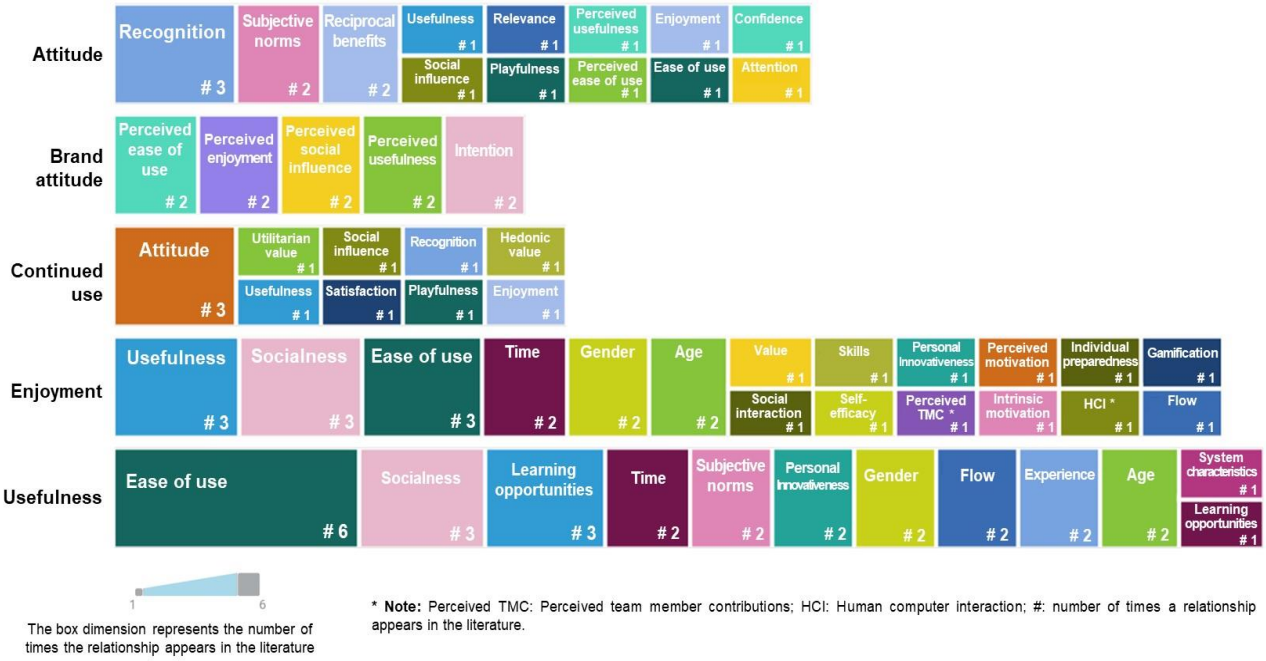

Figure 3 – Breakdown of some of the most important relationships found in the literature

In detail, the number of times that the most important variables appear in literature are presented in **Table 2**.

Table 2 – Number of appearances of the most important variables in literature

	Dependent	Independent
Intention	91	5
Attitude	18	8
Brand attitude	10	0
Continued use	11	2
Enjoyment	27	11
Usefulness	28	6

3.3. Meta-analysis results

According to our methodology, the initial number of relationships was reduced to 21, representing the pair of factors (dependent/ independent) studied at least three times in the literature. Equivalent constructs were joined and considered as a single factor, namely: (i) perceived ease of use and ease of use (Venkatesh et al., 2003), (ii) perceived usefulness and usefulness (Choi & Kim, 2012), (iii) perceived enjoyment and enjoyment (Venkatesh et al., 2012), (iv) perceived social influence and social influence (Venkatesh et al., 2012), and (v) intention to use and continued use (Hamari & Keronen, 2017b).

The meta-analysis results are presented in **Table 3**. Following Hunter & Schmidt's (2014) guidelines we used the untransformed correlations and original sample sizes of each study. The column "Size" represents the cumulative sample sizes, the column "Average β" the average of the correlation coefficient values, "p" the statistical significant of the estimate (p-value), "Z value" the z-score for correlation estimate, and "Confidence interval" the lower and higher bound of 95% confidence interval (Hamari & Keronen, 2017a). Complementing the meta-analysis, we also examined the strength of the independent variables in the relationships identified; presented in column "Weight", assuming that this type of analysis combined with a meta-analysis represents one of the most revealing methods of analysis available (Rana et al., 2015). "Weight" represents the result of the number of times a relationship is found to be statistically significant divided by the number of times it appears in the literature. In the column "Type" we present Jeyaraj et al.'s (2006) best predictors classification, according to (i) "well-utilized", if a relationship is explored five or more times in earlier research, (ii) "experimental", if examined four or fewer times, (iii) "best predictors", if well-utilized with a weight > 0.80 (80%), and (iv) "promising predictors", for the experimental relationships with weight = 1 (100%).

Table 3 – Weight and meta-analysis results

Independent	Dependent	Size	Average β	p value	Z value	Confidence interval (95%)		Weight (sig/total)	Type
Recognition	Attitude	560	0.145	0.001	3.446	0.063	0.225	67% (2/3)	
Intention	Brand attitude	477	0.520	0.000	12.548	0.451	0.583	100% (3/3)	Promising predictor
Ease of use		477	0.025	0.586	0.544	-0.065	0.115	33% (1/3)	
Enjoyment		477	0.134	0.003	2.935	0.045	0.221	100% (3/3)	Promising predictor

Independent	Dependent	Size	Average β	p value	Z value	Confidence interval (95%)		Weight (sig/total)	Type
Social influence		477	0.179	0.000	3.940	0.091	0.265	33% (1/3)	
Usefulness		477	0.132	0.004	2.891	0.043	0.219	100% (3/3)	Promising predictor
Ease of use	Enjoyment	640	0.497	0.000	13.763	0.436	0.553	75% (3/4)	
Socialness		587	0.458	0.000	11.957	0.392	0.520	67% (2/3)	
Usefulness		640	0.035	0.377	0.884	-0.043	0.112	25% (1/4)	
Attitude	Intention	909	0.466	0.000	15.199	0.414	0.515	80% (4/5)	Best predictor
Ease of use		1,641	0.211	0.000	8.67	0.164	0.257	60% (6/10)	
Enjoyment		2,270	0.355	0.000	17.672	0.319	0.390	82% (9/11)	Best predictor
Flow		612	0.120	0.000	2.976	0.041	0.197	33% (1/3)	
Gender		1,608	0.110	0.000	4.425	0.061	0.158	75% (3/4)	
Hedonic value		1,124	0.431	0.000	15.439	0.382	0.477	100% (4/4)	Promising predictor
Socialness		1,380	0.279	0.000	10.635	0.230	0.327	71% (5/7)	
Usefulness		3,248	0.355	0.000	21.143	0.325	0.385	82% (9/11)	Best predictor
Ease of use	Usefulness	1,669	0.408	0.000	17.682	0.367	0.447	100% (6/6)	Best predictor
Learning opportunities		1,868	0.543	0.000	21.095	0.416	0.488	100% (3/3)	Promising predictor
Socialness		587	0.472	0.000	12.389	0.407	0.533	100% (3/3)	Promising predictor
Attitude	Word-of-mouth intention	667	0.476	0.000	13.343	0.415	0.533	67% (2/3)	
Summary effect (random)			0.308	0.000	9.064	0.244	0.369		
Summary effect (fixed)			0.325	0.000	50.388	0.313	0.337		

Note: Sig = number of significant relationships, * p value < 0.005, ** p value < 0.001, ***p value <0.000, summary effect = combined effect of all relationships using a meta-analysis random or fixed method

The meta-analysis results indicate that 19 of the 21 relationships are statistically significant ($p<0.005$). The two exceptions are the relationship ease of use to brand attitude and usefulness to enjoyment, respectively with $p=0.586$ and $p=0.377$. Deepening the analysis from the statistical significant relationships, according to Jeyaraj et al.'s (2006) variables classification, two additional findings can be highlighted from the weight analysis ("Weight" and "Type" columns), namely: four well-utilised relationships were identified as best predictors, and six relationships were classified as promising predictors of gamified technology acceptance. The best predictors identified are: (i) attitude on intention, (ii) enjoyment on intention, (iii) usefulness on intention, and (iv) ease of use on usefulness. The promising predictors identified are: (i) intention on brand attitude, (ii) enjoyment on brand attitude, (iii) usefulness on brand attitude, (iv) hedonic value on intention, (v) learning opportunities on usefulness, and (vi) socialness on usefulness. None of the relationships was considered statistically non-significant across all works; the minimum weight found was 25% in the usefulness

on enjoyment relation. The summary effect for the random effects model is an estimate of the average of the effects across the various studies with different settings and characteristics (Nikolakopoulou et al., 2014), like the ones used in our work. The correlation summary effect obtained with the random method is 0.308, and the 95% confidence interval is between 0.244 and 0.369.

4. Discussion

The present study contributes to the theoretical and empirical discernment of the impact of gamification and its role in the vast space of information systems and academic research. Earlier gamification meta-analysis studies focused on the game perspective examination (Hamari & Keronen, 2017b), we extend gamification analysis to the use of game-design elements in non-gaming contexts, in a utilitarian or instrumental perspective. The burgeoning number of studies, conferences, and books released in recent years has made research on the gamification subject more complex and time-consuming, creating the opportunity to update the state-of-the-art on the matter, identifying and discussing the most important collective findings. Our literature review confirms that results are scattered in nature and report more than 580 different relationships.

From the meta-analysis results, we see that of the 21 relationships selected for analysis 19 are statistically significant. All independent variables influence the dependent variables positively (average of the correlation coefficient values >0). An interesting result is that both enjoyment and usefulness influence brand attitude and intention to use, supporting the fact that users expect to have a balance between these two factors – fun and utility, either in terms of product acceptance or intention to adopt a technology. These aspects are in line with earlier research reporting that a system should have the right amount of utilitarian and hedonic dimensions in order to leverage customer engagement (Hamari & Koivisto, 2015a). In the same manner, attitude was considered a best predictor of intention to use a technology, aligned with earlier studies that also supported it (Ajzen, 1991; Davis, 1989). Considering that the average β indicates the strength of the relationships between independent variable and dependent variables, from the list of statistically significant relationships the top five strongest

relations, all above a threshold of 0.470, are: (i) intention on brand attitude, with 0.520, (ii) ease of use on enjoyment, with 0.497, (iii) learning opportunities on usefulness, with 0.543, (iv) socialness on usefulness, with 0.472, and (v) attitude on word-of-mouth intention, with 0.476. Ease of use over brand attitude was found to be not statistically significant, aligned with the findings reported by others (Yang et al., 2017). The same result of non-significance is reported in the relationship between usefulness and enjoyment, aligned with some earlier studies (Rodrigues et al., 2016b), but contradicting others that did find it significant (Kakar, 2017). Even considering these results, we believe that these two non-significant relationships should still be considered in future new gamification studies due to the low number of studies in literature (below or equal to four), suggesting that additional research is needed. All the statistically significant relationships present a narrow 95% confidence interval, below 0.180 (the widest is usefulness on brand attitude with 0.176). Accepting that the width of these intervals directly depends on the precision of the studies used in our work (Rana et al., 2015), the low width of intervals obtained allows supporting the significance and robustness of the relationships (Baptista & Oliveira, 2016). As expected the 95% confidence interval for the random effects method (0.244 – 0.369) is significantly wider than the one obtained with a fixed-effect method (0.313 – 0.337), aligned with the findings reported by earlier studies (Hunter & Schmidt, 2000).

The combination of weight analysis with the meta-analysis provides an additional view on the significance of the relationships, complementing previous information and reinforcing confidence in our results. From the 21 relationships selected for analysis four were classified as best predictors according to Jeyaraj et al.'s (2006) classification; three variables over intention, namely attitude, enjoyment, and usefulness, and one over usefulness, namely ease of use. Two of the well-utilised relationships; ease of use over intention and socialness over intention, did not reach the minimum weight threshold of 80% identified by Jeyaraj et al. (2006) as the necessary value of statistically significant results in literature to be considered as best predictors. Additional research is also needed to allow us to promote some of the other relationships to the best predictor level. The best candidates for this promotion are naturally the relationships explored four times

in the literature with a weight equal to 1, namely hedonic value over intention which would need only one additional study, even if not statistically significant, to become a best predictor factor. In an equivalent position are two additional relationships that, even not being currently considered as promising predictors, only need one more statistical significant relationship in a future study to become best predictors, namely ease of use over enjoyment and gender over intention, as they would reach the 80% threshold.

Based on the weight and meta-analysis' results it is conceivable to plan a theoretical model able to support future gamification and serious games works, as shown in **Figure 4**. The criteria defined to design the model was: (i) statistically significant relationships identified in the meta-analysis, and (ii) best and promising predictors identified in the weight-analysis. A brief description of each variable included in the theoretical model is presented in **Table 4**.

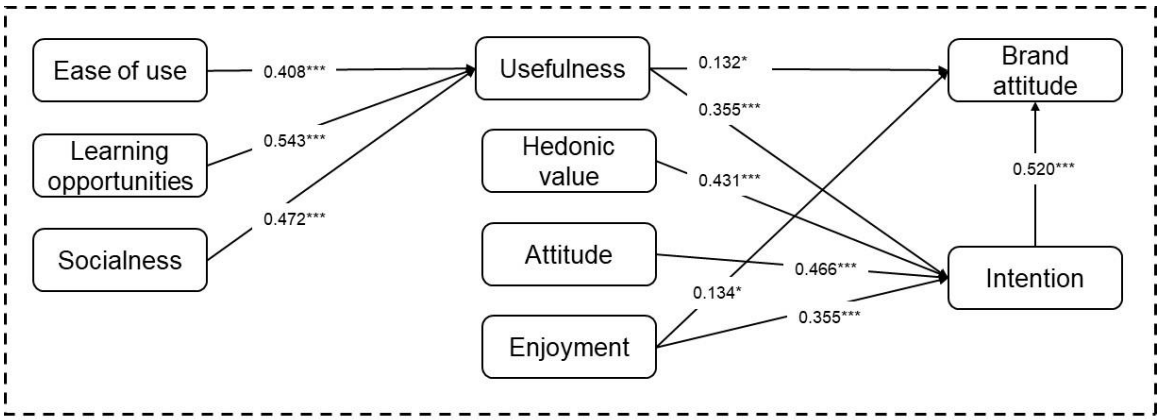

Figure 4 – Theoretical model based on the results of the weight and meta-analysis

Table 4 – Construct definitions and sources

Variable	Description
Ease of use	The degree to which a person believes that using an information system would be free of effort (Davis, 1989)
Learning opportunities	The degree to which a person believes that using an information system can offer him or her opportunities for learning (Bourgonjon et al., 2010)
Socialness	Users' perception of information systems as a social actor (Wakefield et al., 2011)
Hedonic value	Users' perception of fun, pleasure and excitement (Holbrook, 1986)

Variable	Description
Usefulness	The degree to which a person believes that using an information system would enhance his or her job performance (Davis, 1989)
Enjoyment	The extent to which the use of the information system is perceived as enjoyable on its own (Davis, 1989)
Brand attitude	Users' perception and evaluation of a branded product (Mitchell & Olson, 1981)
Attitude	Users' overall evaluation of the systems' use, favourable or unfavourable (Ajzen, 1991)
Intention	The degree to which a person has formulated conscious plans to perform or not perform some specific future behaviour (Warshaw & Davis, 1985)

The meta-analysis made it possible to evaluate the statistical significance of the relationships between variables. These results combined with the weight analysis allowed the identification of the most important factors in gamification and serious games literature. In detail, six antecedent variables and three dependent variables were selected, respectively: (i) antecedents: ease of use, learning opportunity, socialness, hedonic value, attitude, and enjoyment, and (ii) dependent: usefulness, brand attitude, and intention. Individually all these variables have strong literature support, proved by the large number of studies carried out with them. Brand attitude is one of the most important concepts in marketing research (Mitchell & Olson, 1981), usefulness and enjoyment together represent a powerful explanation of what influences intention (Davis et al., 1992), and intention has been applied across a wide range of domains and is considered an efficient means of assessing behavioural outcomes (Venkatesh et al., 2016). All these aspects give substantial theoretical support to the proposed model in terms of overall reliability and consistency, making it suitable to be used in future gamification studies.

Some of the studies used in our work had relatively small sample sizes (<80), and we should recognise that it may have some non-intuitive consequences (Anderson et al., 2017), possibly biasing correlation values that feed the meta-analysis. As no minimum threshold of the sample dimension was defined to accept or reject a work, it is necessary to analyse each of these cases individually. Starting with Chen Hsieh et al.'s (2017) study, which had a sample size of 42, the authors used a standardized method of means difference, with

control groups and standard deviation analysis, and for these reasons it was considered adequate to be used in our study, in line with Anderson et al.'s (2017) guidelines. In the Cheng et al. (2016) study, with a sample size of 53, of the two relationships considered in our meta-analysis one, usefulness over enjoyment, was found to be not statistically significant, and the other, ease of use over enjoyment, was not identified as a promising or best predictor. Neither of those relationships was included in the theoretical support model to support future studies, and therefore no additional measures were taken. In the same manner, no additional actions were taken for the remaining studies with small samples, namely for Çakıroğlu et al. (2017), Bozanta et al. (2016), and Gomez et al. (2010); the relationships identified in these studies were initially eliminated from the meta-analysis, according to the methodology presented in section 2, due to the fact that those relationships were not explored a minimum of three times in the literature.

5. Impacts on research and practice

This study consolidates earlier gamification studies and offers several insights for research and practice. For researchers this work presents a complete list of the most important factors used in gamified systems, services, and business, providing a consolidated and succinct theoretical model able to support future studies on this subject. The meta-analysis' statistically significant relationships allow researchers to assess the best gamification related factors to include in their future studies.

From a managerial perspective, the findings of this research can be beneficial to several different areas and industries. For practitioners, understanding the key gamification factors and significant relationships is of the utmost importance to study, implement, and continuously refine gamified systems, services, and businesses that reinforce engagement, thereby achieving greater product, service or user acceptance. Balancing the right level of gamification and usefulness is not a simple task; it is an iterative process of continuous functionalities' tuning and alignment with users' real needs (Baptista & Oliveira, 2017). This study provides the necessary information to allow system,

service, and applications owners, managers, and developers to leverage gamification benefits, brand recognition, intention, and continued use.

Since gamification implies the repetition of desired behaviours (Robson et al., 2015), collecting online user usage information could provide an additional level of understanding of user needs and wants, reinforcing, even more, gamification positive psychological and behavioural results (Morschheuser et al., 2017). Managers should be able to assess and quantifiably measure the impact that gamification will cause over time - positive and negative ones - complemented with a good feedback mechanism in place, to best position their organisations, systems, or application to capitalise on benefits. Enhancing socialness and the social influence through all available channels, aligned with the usefulness of the application, system, or service, adapting marketing and product campaigns, where and when needed, to the gamification results and users, should be an area receiving additional attention from service providers and institutions.

6. Limitations and future research

Our study has some limitations to be addressed, requiring additional attention and research. First, not all the studies related to gamification and serious games were included in our work. This is due to the fact that they do not present sufficient quantitative information, or because they used different statistical methods, different statistical test(s) or do not present correlation values. Including additional studies and methods could allow to reinforce results or to provide different one's worth analysing. Second, some of the studies used in our work had relatively small sample sizes, so we recommend additional caution when generalising results. Third, hedonic value on intention, gender on intention, and ease of use on enjoyment relationships invite for additional attention and future studies, as they can be updated to gamification best predictors. Forth, as investigators continue to deliver new gamification studies, it would be interesting to update this study with the new results, relationships, and values from that research. New relationships worthy to analyse may arise, such as hedonic value to enjoyment, socialness to brand attitude, or socialness to intention.

Longitudinal studies examining how the gamification intention, acceptance, and brand attitude evolve over time would probably provide additional insights. Very few cultural variables and relationships were identified in the gamification and serious games literature. Considering that culture is increasingly important due to the globalisation of business, culture could play a prominent role in future gamification works. Much of this research needs to be replicated in non-Western cultures before more profound conclusions on gamification are drawn. New technologies like wearable or sensory stimulation offer even more opportunities to extend research on affect, emotions (Liu & Santhanam, 2017), gamification, and technology acceptance, for future research.

7. Conclusions

Gamification is gaining increasing presence and importance in our daily lives, applications, services, and business. We applied a meta-analysis to synthesise and integrate all the earlier literature and information available, contributing to knowledge advancement and reducing the time needed to study this important phenomenon in information systems. A total of 54 studies and 59 datasets meeting the defined criteria, and 586 different and interrelated variables relationships were found in the literature, published in the time-frame between January 2010 and the end of January 2018. From these studies we selected the ones examined at least three times in literature, reducing the final number of relationships to 21, which we then analysed in detail through a weight and meta-analysis. The meta-analysis proved to be exceptionally reliable and consistent in terms of outcomes, with 19 of the 21 relationships being statistically significant. The most important influencing factors in literature were identified and presented in an integrated theoretical model able to support future studies, providing an update on the current state-of-the-art in gamification and serious games knowledge.

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Appendix A – List of studies included in the work

Author	Technology/subject	Respondents	Country
(Baptista & Oliveira, 2017)	Mobile banking	326	Brazil
(Hamari & Koivisto, 2015b)	Information technology	200	USA
(Hamari & Koivisto, 2015a)	Information technology	200	USA
(Landers et al., 2017)	Internet application	240	USA
(Bourgonjon et al., 2010)	Multimedia/hypermedia systems	858	Belgium
(Hsu et al., 2017)	Internet application	307	Taiwan
(Yang et al., 2017)	Marketing system	132	UK
(Buckley & Doyle, 2017)	E-learning	95	Ireland
(Çakıroğlu et al., 2017)	E-learning	37	Turkey
(Rodrigues et al., 2017)	E-banking	219	Portugal
(Liang et al., 2017)	E-booking	3,830	China
(Mekler et al., 2015)	Information systems	273	Switzerland
(Koivisto & Hamari, 2014)	E-health	195	Finland
(Rodrigues et al., 2016b)	E-banking	183	Portugal
(Sande et al., 2015)	Serious e-game	106	Netherlands
(Darban et al., 2016)	ERP	252	USA
(Hamari et al., 2015)	E-learning	134	USA
(De-Marcos et al., 2016)	E-learning	167	Spain
(Boyle et al., 2017)	Internet application	237	USA
(Lin et al., 2017)	E-learning	150	Taiwan
(Oleksy & Wnuk, 2017)	Augmented reality	279	Poland
(Morschheuser, et al., 2017)	Augmented reality	206	Germany
(Nelson et al., 2016)	E-health	210	USA
(Bachen et al., 2016)	E-learning	146	USA
(Bozanta et al., 2016)	Virtual system	43	Turkey
(Chen et al., 2017)	Smartphone use	384	China
(Bourgonjon et al., 2013)	E-learning	505	Belgium
(Beard & Wickham, 2016)	Internet application	600	USA
(Su et al., 2016)	Mobile application	394	Taiwan
(Baek & Touati, 2016)	E-learning	164	South Korea
(Tan et al., 2016)	Information systems	148	Singapore
(Hong et al., 2013)	Internet application	80	Taiwan
(Kong et al., 2012)	E-learning	94	China
(Rodrigues et al., 2016a)	E-banking	183	Portugal

Author	Technology/subject	Respondents	Country
(Herzig et al., 2012)	ERP system	112	Germany
(Galbis-Córdova et al., 2017)	E-learning	128	Spain
(Mulcahy et al., 2017)	Information systems	497	Australia
(Codish & Ravid, 2014)	E-learning	102	Israel
(Codish & Ravid, 2017)	E-learning	235	Israel
(Teensma, 2016)	E-health	160	Holland
(Herzig et al., 2015)	ERP	112	Germany
(Feng et al., 2018)	Crowdsourcing system	295	China
(Macey & Hamari, 2018)	Information systems	613	Finland
(Hsieh et al., 2017)	E-learning	42	Taiwan
(Hone & El Said, 2016)	E-learning	379	Egypt
(Ozturk et al., 2016)	E-booking	396	USA
(Sepehr & Head, 2017)	E-learning	114	Canada
(Buil et al., 2016)	E-learning	207	Spain
(Rouibah et al., 2016)	E-payments	350	Kuwait
(Gomez et al., 2010)	E-learning	73	USA
(Turel et al., 2010)	E-commerce	422	Canada
(Hsiao & Tang, 2016)	E-commerce	388	Taiwan
(Gan & Li, 2018)	Mobile application	326	China