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Gamification of education and learning: A review of empirical literature

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Abstract: Gamification has become one of the most notable technological developments for human engagement. Therefore, it is not surprising that gamification has especially been addressed and implemented in the realm of education where supporting and retaining engagement is a constant challenge. However, while the volume of research on the topic has increased, synthesizing the consequent knowledge has remained modest and narrow. Therefore, in this literature review we catalogue 128 empirical research papers in the field of gamification of education and learning. The results indicate that gamification in education and learning most commonly utilizes affordances signaling achievement and progression, while social and immersion-oriented affordances are much less common; the outcomes examined in the studies are mainly focused on quantifiable performance metrics; and the results reported in the reviewed studies are strongly positively oriented. The findings imply that future research on gamification in education should increasingly put emphasis on varying the affordances in the implementations and the pursued goals of the gamification solutions. We encourage also increased attention on contextual factors of the solutions as well as on study designs in future research endeavors.

1. Introduction & background

Gamification, the design approach of utilizing gameful design in various contexts for inducing experiences familiar from games to support different activities and behaviors (Huotari & Hamari, 2017; Deterding et al., 2011), has continued to be a popular topic within both industry and academia since its popularization in the early 2010's. Gamification has gained significant attention especially in educational contexts (Koivisto & Hamari, 2017; Seaborn & Fels, 2015). Gamifying education and learning has a long history (see e.g. Deterding, 2014) and an intuitively understandable background as game design and theories on learning draw heavily from same psychological theoretical backgrounds (Landers, 2014). Via the technological advancements enabling more digitized learning environments as well as use of e.g. technical possibilities developed in relation to video games to create immersive and engaging learning experiences, the trend of gamification of education and learning has been only increasing.

The long history and varied ways of incorporating gameful interactions to educational contexts has also lead to varying terminology for the approach, e.g. serious games, edugames or games for education, game-based learning, and lately, gamification (Landers, 2014; Seaborn & Fels, 2015; Deterding, 2014). In the current study we have not made distinctions based on terminology but instead consider all of these varied approaches to be manifestations of gamification of education and learning.

Existing reviews on gamification literature have indicated that education and learning are the most common contexts for empirical research of gamification (Koivisto & Hamari, 2017; Hamari, Koivisto & Sarsa, 2014; Seaborn & Fels, 2015). Literature reviews on gamification of education and learning specifically have also been conducted, however, all of these reviews have limited their scope in one way or another: Caponetto et al. (2014) as well as Marti-Parreño et al. (2016) concentrate mainly on bibliometric analyses and terminological aspects. Marti-Parreño et al. (2016) also categorize constructs studied in the literature. Some literature reviews have been limited by the number of studies included: de Sousa Borges et al. (2014) limited their review to 26 studies; Dicheva et al. (2014) included only 36 studies, and Dichev and Dicheva (2017) have reviewed 63 studies. Nah et al. (2014) have included 15 studies in their review. As is evident, the prior reviews have not been extensively inclusive in their review procedures and a large part of the literature has not been covered to date.

In this review, we conduct a literature review of 128 empirical research papers in the field of gamification of education and learning. We provide the most extensive overview to date of the existing body of literature on the topic. We analyze how gamification has been implemented in the studies in the education domain, i.e. what types of motivational affordances have been implemented in the literature, what kind of psychological and behavioral outcomes has the gamification been expected to lead to, and finally, what kind of results have been reported in the studies

2. Review procedure

The literature searches were conducted in the Scopus database, which was chosen for the reason that it indexes all of the other potentially relevant databases, for example ACM, IEEE, Springer, DBLP Computer Science Bibliography, and the AIS Electronic Library. Using only one comprehensive database instead of conducting searches in various repositories was preferred to increase the rigor and clarity of the data gathering (see e.g. Paré et al. 2015). The search for literature in the Scopus database was conducted using the search query: TITLE-ABS-KEY (gamif*). The search was limited to include conference papers, articles, articles in press, reviews and book chapters, in order to exclude non-academic publications. The search query was limited to publication metadata (i.e. title, abstract and keywords) as it was considered that inclusion of a term derived from the root gamif* in the metadata would indicate the relevance of the paper for the review. The literature search was conducted in 6/2015 and resulted in 807 hits. The literature review process is reported in Figure 1.

The retrieved papers were categorized in terms of the type of the publication as well as the domain in which the study had been conducted. Of the whole body of literature, 270 studies were identified as full, empirical research papers. Papers were considered to be empirical if some data had been gathered, the data gathering was reported, and analyses had been conducted on the data. Of these 270 studies, 128 empirical research papers were identified as studies in the domain of education and learning. Papers were categorized to be in the education and learning domain if the study was conducted in an educational context. No restrictions in terms of educational level or content were

applied. The 128 empirical papers in the domain of education and learning thus form the body of reviewed literature. Full references to the reviewed studies can be found from the online Appendix.

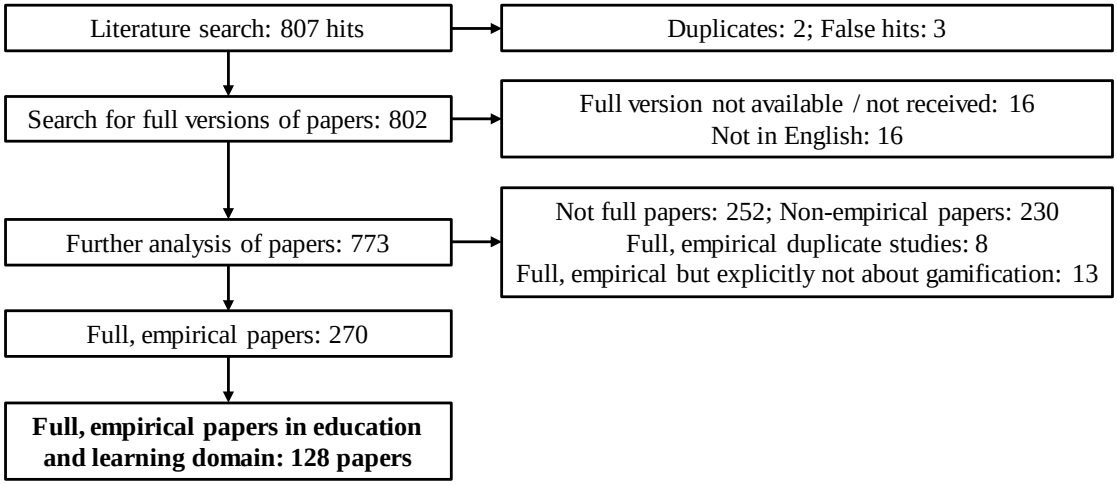

Figure 1. A flowchart describing the literature review process.

Following the guidelines of Webster and Watson (2002), the identified papers were analyzed first author-centrically and then concept-centrically. The units of analysis were defined prior to the analyses. Author-centric coding was conducted by checking the pre-defined units of analysis from each paper and coding them as the paper was read. Through this procedure, a matrix of the coded literature was produced. In the concept-centric analysis phase the coded literature was then organized based on further units of analysis. As suggested by Webster and Watson (2002), the coded concepts were comprised into frequency tables, which form the core of this review.

3. Analysis

In the reviewed body of literature, the most common affordances were different point, challenge, badge and leaderboard-type affordances (see Table 1). The same affordances have been noted to be the most frequently implemented ones in gamification research on a general level (Hamari, Koivisto & Sarsa, 2014; Koivisto & Hamari, 2017) as well as in the context of education (Nah et al., 2014; Dicheva et al., 2015; Dichev et al., 2017). These affordances can all be categorized as achievement and progression oriented elements, which form the most common category of affordances in the reviewed literature. Socially oriented affordances form the second common category of elements in the given domain.

The use of immersion-oriented affordances has been significantly less frequent in the education and learning domain. This is an interesting finding considering that different types of (gameful) simulations and increasingly also virtual reality solutions are fairly common in educational contexts. However, the research conducted in these field potentially does not consider the work as gamification-related, and the differing terminology could explain that such studies are not present in the current body of literature.

Most of the reviewed empirical research papers introduced or examined an implementation including several affordances. On average, the papers reported the gamification solutions to contain four affordances.

Table 1. Affordances studied in the empirical research papers.

Achievement/progression		**Immersion**	
Points, score, XP	67	Avatar, character, virtual identity	15
Challenges, quests, missions, tasks, clear goals	53	Narrative, narration, storytelling, dialogues, theme	13
Badges, achievements, medals, trophies	47	Virtual world, 3D world, game world, simulation	9
Leaderboards, ranking	47	In-game rewards	6
Levels	35	Role play	3
Quizzes, questions	25	**Non-digital elements**	
Progress, status bars, skill trees	19	Check-ins, location data	8
Performance stats, performance feedback	18	Real world/financial reward	2
Timer, speed	13	Motion tracking	1
Increasing difficulty	8	Physical objects as game resources	1
Social		**Miscellaneous**	
Cooperation, teams	31	Assistance, virtual helpers	9
Social networking features	14	Virtual currency	7
Competition	12	Retries, health, health points	6
Peer-rating	10	Full game (also board games), also undescribed commercial gamification systems	5
Customization, personalization	3	Adaptive difficulty	3
Multiplayer	2	Game rounds	2
		Onboarding (safe environment to practice)	2
		Reminders, cues, notifications, annotations	2
		Penalties	1

The most common psychological outcomes studied in the reviewed papers were use experiences and perceptions of system and features (Table 2). These were commonly studied with various self-developed instruments to gauge the experiences of the users. Perceived enjoyment, fun, engagement, motivation, and perceived usefulness were also commonly studied psychological outcomes. These outcomes correspond with the common discourses of what gamification is thought or expected to result in (see e.g. Koivisto & Hamari, 2017; Rigby, 2014; Seaborn & Fels, 2015). The findings regarding the psychological outcomes are convergent with previous reviews on gamification literature in general (Hamari, Koivisto & Sarsa, 2014; Koivisto & Hamari, 2017) as well as in the context of education and learning (Martí-Parreño et al. 2016).

The most studied behavioral outcomes were grades, participation in a system, and speed of conducting tasks and assignments (Table 3). In the context of education this seems logical as such outcomes are often the quantifiable goals of education. Interestingly, inducing any sort of social interaction has very rarely been the behavioral goal of the gamification solutions. This finding is in line with the general trend of gamification implementations not being often designed to support collaborative action and cooperation (Koivisto & Hamari, 2017).

Furthermore, we analyzed the results of the studies in the current body of literature. We only included studies containing analyses with quantitative methods in this analysis due to them providing more easily categorizable results. A significant portion of these studies report positively leaning results from use of gamification in the education and learning domain (Table 4).

Table 2. Psychological outcomes studied in the empirical research papers.

Overall assessment / general attitude of the use of the gamified system		**Attitude**	
Perceptions of use, use experience, perceptions of system and features	30	Satisfaction	3
Perception of course, perception of gamification in education	4	Attitude	2
Preference of system type/features	3	**Social interaction**	
Affective		Relatedness	3
Perceived enjoyment, fun	14	Perceived competition	3
Engagement	11	Recognition	1
Flow	3	Subjective norm, social influence	1
Affect, emotional experience	1	Perceived socialness, social context	1
Immersion	1	Social comparison	1
Cognitive		**Psychological states and traits / personality features**	
Perceived usefulness, perceived effectiveness	11	Motivation (also orientation towards various motivations)	11
Perception of learning	4	Perceived competence	5
Perceptions of additional benefits	3	Interest	4
Involvement, participation	2	Self-efficacy, confidence	2
Effort in use / Experienced challenge		Autonomy	2
Effort, perceived difficulty, challenge	6	Empowerment	1
Workload	3	Personality, user types	1
Perceived stress, cognitive load	2	Familiarity	1
Frustration, annoyance	2	Identification	1
Ease of use	1		

Table 3. Behavioral outcomes studied in the empirical research papers.

Performance		**Engagement / interaction with the system**	
Course grade, assignment grade, academic performance	27	Participation in a system, system use	16
Speed, time	15	Participation in discussions	9
XP, points, score gained	11	Course material views, downloads	9
Learning, skill progression	11	Course attendance, exam attendance	6
Badges gained, tracking of badges	8	Use intentions, willingness to use/continue	1
Number of assignments, amount of contributions in class	7	Knowledge transfer	1
Number of attempts	5	**Physical etc. measures**	
Amount of contributions/content produced	4	Stress level	2
Accuracy	2	Psychophysiological measures	1
Leaderboard positions	2	**Social interaction**	
Quality of contributions	1	Cooperation	1
Acting on time	1	**Miscellaneous**	
		Functionality of software	1
		Retention and attrition of users	1
		Behavioral strategies	1

Table 4. Results of studies containing analyses with quantitative methods.

	Mainly positively oriented	Null or equal positive and negative	Mainly negatively oriented	Total
Number of papers	65 *71,43 %*	23 *25,27 %*	3 *0,03 %*	**91** ***100 %***

The qualitative results in the body of reviewed literature similarly reported positively oriented findings for many studies. However, due to the nature of qualitative data and methods allowing richer analysis, many of the studies also reported mixed results. Commonly the qualitative results contain a mention of e.g. some users benefitting from and being motivated by the gamification while others do not. As a large portion of the research on gamification is being conducted with quantitative methods, this finding suggests that some effects and reactions to gamification are potentially not being reached via the most commonly employed research approaches.

We also examined the results of studies containing analyses with quantitative methods categorized by affordances implemented in the studies. Badges, leaderboards, and points were the most common affordances in studies with quantitative analyses (Table 5). As previously mentioned, the reviewed research papers studied gamification implementations containing on average 4 affordances. When further scrutinizing the body of literature, we identified only 28 studies that contained a controlled experimental study design, and of these, only 7 studies examined the effects of one element at a time. This is an issue that has been identified in gamification research on a general level (Hamari, Koivisto & Sarsa, 2014; Koivisto & Hamari, 2017): even though the results are positively oriented, it is difficult to estimate the effect of each motivational affordance or their interaction on the outcomes and the results as controlled study designs are not commonly employed.

4. Discussion

In this literature review we have reported the most extensive overview of empirical research literature on gamification of education and learning to date. We have analyzed a body of literature containing 128 empirical studies examining gamification in educational contexts in terms of how the gamification has been implemented, what kind of outcomes it has been expected to lead to, and what kind of results have been reported.

The findings of the analyses indicate that the gamification studies in the context of education strongly converge with the general research on gamification with regards to the implemented affordances and psychological outcomes (Hamari, Koivisto & Sarsa, 2014; Koivisto & Hamari, 2017; Seaborn & Fels, 2015). Understandably, however, the behavioral outcomes are more focused on various quantifiable educational outcomes, such as course and assignment grades, when compared to gamification research in other settings.

In terms of the results of the reviewed studies, a considerable majority of the studies reported mainly positively oriented results. However, while the results seem promising, there is also a significant amount of research with null or mixed results. As pointed out in the analysis, the reports of qualitative results often indicate very varying experiences and outcomes even when the general tendency of the findings would be positively oriented. Consequently, the findings regarding the considerable majority of research reporting positively leaning results should be considered with caution.

Table 5. Results of studies containing analyses with quantitative methods by affordances implemented in the studies (N=91)

Affordance	Mainly positively oriented	Null or equal positive and negative	Mainly negatively oriented	Sum
Points, score, XP	38	13	1	52
Leaderboards, ranking	27	13	3	43
Badges, achievements, medals, trophies	25	12	2	39
Challenges, quests, missions, tasks, clear goals	27	8	2	37
Levels	19	7	2	28
Cooperation, teams	17	2	2	21
Quizzes, questions	15	3		18
Progress, status bars, skill trees	13	2	1	16
Social networking features	11	1	2	14
Performance stats, performance feedback	13	1		14
Timer, speed	12			12
Narrative, narration, storytelling, dialogues, theme	10	1		11
Avatar, character, virtual identity	8	1		9
Competition	7	1		8
Assistance, virtual helpers	6	1		7
Retries, health, health points	6			6
Increasing difficulty	6			6
Peer-rating	5			5
In-game rewards	5			5
Check-ins, location data	5			5
Virtual world, 3D world, game world, simulation	4	1		5
Virtual currency	3	1		4
Full game (also board games), also undescribed commercial gamification systems	1	2		3
Customization, personalization	2	1		3
Adaptive difficulty	3			3
Multiplayer	2			2
Onboarding (safe environment to practice the rules)	1	1		2
Reminders, cues, notifications, annotations	1	1		2
Real world/financial reward	1	1		2
Role play	1			1
Game rounds	1			1
Motion tracking	1			1
Penalties	1			1
Total	**297**	**74**	**15**	**386**

To address the challenges of the existing research, some suggestions for future research are provided. Firstly, prior research has indicated that there are several contextual factors affecting the experiences from gamification in each situation, e.g. demographic (Koivisto & Hamari, 2014) and personality factors, the associations attached to the task or activity in general (Hamari, 2013), and the temporal and spatial context (Deterding, 2015). Congruently with previous research, the results of this review also indicate that future research should pay more attention to the contextual factors

affecting the gamification as potential source for the varying results (Hamari, Koivisto & Sarsa, 2014; Koivisto & Hamari, 2017). Furthermore, since we as individuals have different learning styles in addition to our personality and demographic characteristics, future research endeavors are encouraged to also address these in the gamification solutions as well as in study designs.

Secondly, as noted in the analyses, most of the studies were conducted with gamification implementations containing several affordances without controlling the effects of each to the outcomes. More attention should thus be paid on the study designs to produce knowledge on the effects of isolated elements in educational settings. Moreover, employing controlled study designs and further triangulating the results with various sources of data is encouraged.

Thirdly and finally, based on the analyses of the current body of research on gamification in education and learning, there are a few clear thematic gaps in the existing research. We recommend future research to expand the scope of affordances implemented in the context of education and to explore gameful educational solutions incorporating especially more socially and immersion-oriented affordances. Furthermore, we suggest that future research could seek to focus more on inducing social interaction with the gamification solutions.

5. Limitations

As noted above, in this review we have included all the literature published under the flag of gamification. In this paper, we consider the term gamification to act as an umbrella term for various kinds of gameful solutions in educational and learning context. Thus studies where the term gamification has not been included are outside the scope of this review. Furthermore, we have not limited the data in terms of educational level or type of education. In other words, the reviewed studies contain studies on gamification e.g. in higher education and vocational training as well as in basic education. This criterion to include all empirical studies exploring gamification in any educational or learning context is also the most probable reason for the significant difference between the number of reviewed papers in this and in prior reviews on gamification of education research.

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Appendix

The full references of the reviewed studies can be found from the online appendix: https://www.dropbox.com/s/a6gngp4f7xnb8b1/Gamification_of_Education_and_Learning-Appendix.pdf?dl=0