Gamification in education: Real benefits or edutainment?

Jihan Rabah[a], Robert Cassidy[b], Robert Beauchemin[a]

[a]eConcordia, Concordia University, Montreal, Canada
[b]Centre for Teaching and Learning, Concordia University, Montreal, Canada

Abstract

Gamification of learning – the application of game design elements to learning activities – is currently a hot, if controversial, trend in education. Proponents of gamification, on the one hand, claim that gamification leads to learning gains. They assert that gamification reinforces important skills in education, such as problem-solving, collaboration, and communication. Furthermore, they maintain that need for interaction in a gamified approach to education encourages students to play an active role in the learning process, thereby increasing student engagement in online forums, projects, and other learning activities. Detractors of gamification, meanwhile, argue that it derails learning with aimless distractions, adds unnecessary competition stress, and fails to take into account certain learners' pedagogical needs. Research on gamification is gathering momentum and promises to help adjudicate many of the issues raised in this controversy. We therefore conducted a second-order review to examine the evidence-based discourse on this aspect of gamification. We found that while the review literature adequately summarizes evidence in support of effectiveness in terms of cognitive, emotional/motivational, and behavioural outcomes, certain design issues remain unaddressed. When addressing effectiveness, a concern for how the nature of learning objectives and the quality of learning activities that are gamified is noticeably absent in the field. Furthermore, a contextual bias towards STEM courses limits the generalizability of evidence to other contexts. The review literature further suggests a publication bias and an over-emphasis on positive effects. Nevertheless, recognising the general scope of the research, its theory, and evidence, will help instructors and curriculum designers interested in gamifying courses decide how to approach gamified course designs to use in a specific context. Highlighting current limitations in the evidence-based discourse may benefit the design of future research by drawing attention to the types of evidence that will help advance gamification in educational settings.

Keywords: gamification in education, higher education, learning design elements, motivation, engagement, learning outcomes

1. Background

Gamification has been applied in several domains, including education, business, fitness and health domains, but the research field of gamification in education is still in its emergent stages. Despite Piaget's early advocacy of games as a way for children to meaningfully interact with and learn from their environments, it was not until recently that research on games in education gained momentum. Indeed, as of 2013, only 26% of scientific publications in gamification were about its practical application in education (Seaborn and Fels, 2013), with the first seminal framework of gamification published only a few years ago (Deterding et al, 2011).

Despite its late arrival, its popularity has grown rapidly, largely due to expectations around its ability to solve a perennial challenge of traditional learning environments: making learning interesting and engaging. With the advancement of social media and online gaming, as well as the widespread use of smart devices, the task of keeping students motivated to learn has become even more challenging. The introduction of gamification into the classroom stems from the premise that the nature of games and what makes them fun increases students' intrinsic motivation to engage in learning activities (Adams and Dormans, 2012). The inherent interactivity of games is also thought to maximize students' involvement in the learning process, thereby supporting active learning, problem-based learning, and experiential learning (Oblinger, 2004).

Many educators hope that gamification will not only increase students' motivation to learn but also make participation in schoolwork more effective and meaningful. The emerging literature seems to uphold this view, with evidence that gamification may be linked to higher numbers of passing students (de Marcos et al, 2017). Gamification of learning environments may constitute a powerful tool for the acquisition of knowledge, and might enhance important skills such as problem-solving, collaboration, and communication (Dicheva et al, 2015). Critics, however, argue that gamification derails learning with aimless distractions, adds unnecessary competition stress, and fails to take into account certain learners' pedagogical needs. The value of gamification in education remains controversial, despite an increasing number of empirical studies and literature reviews that may inform this controversy. The present study aims to ascertain the extent to which literature reviews in the field of gamification are adequately addressing relevant issues to inform this debate.

2. Definition(s) of Gamification in Education

In defining the scope of our study, we build on the definitions of gaming, game design elements and gamification set out by Deterding et al (2011). First is the differentiation between 'gaming' and 'playing'. While playing is a freeform, creative and open-ended process, gaming is a highly structured process oriented toward discrete, clearly defined goals. Gamification, then is defined as "the use of game design elements characteristic for games (rather than play or playfulness) in non-game contexts"(p. 13).

Game design elements are more difficult to define, owing to the multiple theoretical frameworks that have been produced, each with idiosyncratic classification systems and levels of abstraction. Useful for the current study is the synthesis by Dicheva et al (2015) of the more prominent frameworks found in the literature (e.g., Deterding et al, 2011; Zichermann and Cunningham, 2011). Table 1 summarizes the synthesized framework, which classifies game design elements into two levels of abstraction – game design principles and game mechanics – with exemplars of each.

Design principles	Mechanics
Visible status	Badges
Social engagement	Points
– competition	Levels
– cooperation	Rewards
– collaboration	Leaderboards
Freedom of choice	Progress bars
Freedom to fail	Currency
Rapid feedback	Avatars
Goals & challenges	Countdown clock
Customization	
Access, unlock content	

Table 1: Game design elements: Classification framework

Common game design principles are those of visible status, social engagement, freedom of choice, freedom to fail, and rapid feedback (Dicheva et al, 2015). Visible status, informs students about a task's completion status or else shows students how they are progressing. Social engagement feeds into purported needs for competition against individuals or teams (O'Donovan et al, 2013) but may include team projects and group learning opportunities (Mak, 2013), as well as cooperation and interaction with classroom peers (Landers and Callan, 2011). Freedom of choice implies that students are free to choose whichever task(s) they want to complete. For instance, in Holman, Aguilar, and Fishman (2013), students could choose between writing an essay, a class blog, a group project, or an individual project, while in DeShutter and Abeele (2014) options included making a YouTube video, designing an educational game, or writing academic essays. The freedom to fail principle is exemplified in contexts where students were given the chance to submit assignments again and to revise their work without a penalty (Hentenryck and Coffrin, 2014). Rapid feedback refers to the gaming context enabling students to receive feedback on their learning performance.

Commonly studies game mechanics are badges, points, levels and rewards. As the more concrete level of elements, game mechanics are more contextualized than design principles, more adapted to the specifics of a given learning environment. Badges generally are icons associated with a learner's profile that signal accomplishment and can be linked to several design principle, such as visible status, goals and challenges. Points are generally accrued for performance or participation and are given to reward desired learning behaviours. Again, they can be linked to and promote several design principles (e.g., visible status, rapid feedback, competition, etc). Mechanics generally represent an instantiation of a game design principle. For example, the principle of visible status can be instantiated through the use of a leaderboard, badges, etc. A single principle may be operationalized by more than one mechanic. By the same token, a single mechanic can operationalize multiple principles. For example, a leaderboard can operationalize visible status and social engagement. The combinatorial relations among principles and mechanics raises an important caution in interpreting the effectiveness of a mechanic without considering which principle(s) it is used to instantiate, and vice versa.

Gamification, then, is defined as 'the use of design elements characteristic for games (rather than play or playfulness) in non-game contexts' (Deterding et al, 2011, p 13). The focus on game design elements intentionally excludes the consideration of 'serious games' or whole educational games when referring to gamification, as these types of games are so idiosyncratic to context as to not be generalizable and are prohibitively resource-intensive to produce; they are exceedingly rare in educational contexts and out of scope for the current study. Gamification in education therefore is defined as the use of game design elements in in the context of formal higher education and with the intention of supporting the acquisition of course-specific learning objectives. Our study aims to characterize the current state of discourse in the educational gamification field by examining the literature review articles, each summarizing the field's evaluation of gamification in education.

3. Objective and Methodology

The overall objective of this study is to describe the extant corpus of relevant literature reviews in order to characterize the discourse over effectiveness of gamification of learning in higher education. The assumption driving this second-order review is that literature reviews and meta-analyses most effectively inform evidence-based discourse over issues of effectiveness of educational innovations, but can unwittingly introduce blindspots into the discourse. A careful characterization of the review literature therefore will allow us to present a current snapshot of the 'state of the evidence' as well as identify any blind spots or gaps that may limit the utility of that evidence in adjudicating debates over the effectiveness of gamification. A clear understanding of the gamification in education research field would likely help researchers and educators marshal and qualify relevant evidence in discussions over the usefulness and impact of gamification.

Our review focuses on the evidence for effectiveness of gamification in education, framed by three specific questions:

1. What are the types of outcomes currently used to decide effectiveness?
2. What are the types of game design elements used to decide effectiveness?
3. What limitations can be addressed to better inform discourse over effectiveness?

We present here a second-order review – a qualitative analysis of the review literature on gamification in education, published in the past 5 years (2014 – 2018). We conducted systematic searches using specific keywords to identify relevant reviews in the field of gamification in education and targeting higher education populations in particular. First, we performed a Boolean AND search of key terms on the Google Scholar and Educational Research Information Center (ERIC) databases. The terms were: review, gamification, learning, higher education. We followed up this search with a set of inclusion/exclusion criteria where the final articles included in this study had to satisfy the following criteria: published in the last five years, pertained to higher education settings, used a form of gamification for education, and did not use serious games or whole educational games when referring to gamification.

Our search yielded 54 reviews, 10 of which met our inclusion criteria and were analyzed in-depth. (Included reviews are marked with an asterisk in the References section). Our review is descriptive in nature, synthesizing findings around what the literature reviews uncovered with regards to patterns and interpreted findings, theories, or recommendations on the area of gamification in education.

4. Findings

Our examination of the relevant reviews allows us to summarize the core activities, nature of evidence and interpretations currently informing discourse in the field of gamified education.

4.1. What outcomes are currently used to decide effectiveness?

Effectiveness of gamification is often dealt with in the research literature, yet it is broadly construed around various outcomes. For example, Mart-Parreo et al (2016) describe a theme in the literature, termed 'effectiveness', that includes cognitive outcomes as well as various attitudes and emotions about the gamification experience. The authors also include a separate theme, 'engagement', which is also considered a relevant outcome to decide effectiveness in a broader sense. Indeed, in addition to cognitive learning gains, the outcomes most commonly considered for effectiveness of gamification in education are motivation and engagement (Bell, 2017; Faiella et al, 2015; Hamari et al, 2014). We consider these outcomes in turn.

4.1.1. Cognitive learning outcomes

When considered, reviews generally reported that gamification had positive effects on cognitive learning outcomes (Bevins and Howard, 2018; Hamari et al, 2014; Kim et al, 2018). Scholars reported that learning achievement, procedural and declarative knowledge, higher order thinking skills were enriched by adding a gamification layer (Kim et al, 2018). Gamification, does appear to improve learning outcomes on lower-risk assignments (e.g., quizzes and practical activities) and overall course marks but does not appear to significantly influence performance on final exams (Bevins and Howard, 2018). In summary, the review literature supports the claim that well-designed, properly deployed gamification can improve learning outcomes in different conditions.

Though effectiveness in terms of cognitive learning outcomes is most closely aligned with the objectives of higher education courses, literature reviews found a disproportionately low emphasis on this outcome. We suggest several reasons for this discrepancy. First, the effectiveness of gamification on learning outcomes may depend on the nature of the learning outcomes targeted (there are many frameworks to provide texture and nuance to these, such as taxonomies elaborated by Bloom, Fink, Biggs, and others). Also critical are the nature and design of the learning activities that are gamified to achieve these outcomes. Motivation for and engagement with effective learning activities will more likely lead to improved learning outcomes, while ineffective learning activities may not, no matter how much motivation and engagement is mustered. A layer of complexity therefore arises in that the effect of gamification of learning outcomes requires contextualization with respect to learning outcomes and is probably mediated by the effectiveness of gamified learning activities on achieving those outcomes. Nevertheless, the most obvious reason for the lack of emphasis on cognitive outcomes is a pervasive perception that the primary affordance of gamification is motivation and engagement.

4.1.2. Motivation and emotion

A majority of the literature reviews showed positive effects of gamification on motivation (Alsawaeir, 2018; Bell, 2017; Bevins and Howard, 2018; Dicheva, 2015; Faiella, 2015). Students perceived gamified courses to be more motivating, interesting, and conducive to learning than other courses (Dicheva et al 2015). Particularly, gamification elements transform boring tasks into interesting ones (Faiella et al, 2015). Emotional outcomes generally focused on constructs such as motivation, attitude, and enjoyment, which were investigated via interviews or questionnaires (Alsawaeir, 2018; Hamari et al, 2014). Scholars in the field recommend further research on the impact of gamification on motivation. To better grasp the effect of gamification on motivation effectively, researchers need to conduct longitudinal studies or at least identify which combinations of game design elements are most likely to stimulate intrinsic motivation (Alsawaier, 2018).

4.1.3. Engagement and behaviour

With regards to gamification and its effect on learners' engagement, literature reviews generally target engagement as an

outcome in itself (Alsawaier, 2018; Bell, 2017; Bevins and Howard, 2018; Dicheva et al, 2015; Faiella et al, 2015; Mart-Parreo et al, 2016; Ortiz et al, 2016). Studies examining effects of engagement revealed, again, mostly positive results. These included significantly greater student engagement in forums and projects; higher rates of attendance, participation, and material downloads; increased quantity (and continued quality) of student contributions/answers, higher passing rates, increased volunteering, and undertaking of difficult assignments; as well as a reduction in student achievement gaps (Dicheva et al, 2015). Interestingly, participation results in greater student engagement, particularly if individuals are free to select a preferred mode of learning (Faiella et al, 2015). In addition, the better the alignment of coursework, core content, and game elements, the greater the positive the effect on gamification and engagement. This is especially true if such aspects are linked to a central narrative (Bell, 2017).

4.1.4. Relations among outcomes

The relations among the cognitive, emotional and behavioural outcomes are likely complex and nuanced. For example, learning gains resulting from gamification show that results are not tied to motivation and engagement only. In fact, Sitzmann et al (2011) disclosed that gamification in education also helps self-efficacy and boosts knowledge retention. Faiella et al (2015) revealed that gamification helps lower anxiety or worry over the consequences of not doing well. In addition, gamification aids in building communities, where participants share tips and celebrate accomplishments on a whole class level, not only academic high-achievers (Faiella et al, 2015). Meta-analytic studies demonstrate that gamification might be quite beneficial and help students achieve better outcomes when certain elements are present (Garland, 2015). These include applying a gamification layer to courses that last shorter time periods, such as short-term courses or modules within courses (Garland, 2015). Gamified courses should include elements that demonstrate time spent on tasks since poor time management is inversely related to positive results (Garland, 2015). Last but not least, feedback that is ongoing, immediate, and meaningful can have a positive effect on learning outcomes (Faiella et al, 2015).

4.2. What are the types of game design elements used to decide effectiveness?

4.2.1. Game mechanics

The literature reviews reveal that the most typically used game mechanics were points, badges, and leaderboards, (Bevins and Howard, 2018; Hamari et al; 2014; Ortiz et al, 2016). However, gamification is not only about using game mechanics in courses, but rather using them to overcome challenges in education and meeting objectives (Kim et al, 2018), a function that falls closer to the game design principles level in Table1. In light of that, to better grasp the effect of gamification mechanics on engagement and motivation, researchers need to study how game mechanics interact with design principles, and which couplings work well together, in what contexts (Alsawaier, 2018). Furthermore, these game design elements

should be considered also in light of their coupling to 'learning design elements', what we introduce here as the analogical counterparts to game design elements: 'learning design principles' and 'learning mechanics'. To properly inform discourse on effectiveness of gamification in learning, the design principles and mechanics of both gamification and learning must be considered together.

4.3. What limitations can be addressed in order to better inform discourse over effectiveness?

4.3.1. Context

The literature reviews synthesized here show that context plays an important role in gamification (Alsawaier, 2018; Dicheva et al, 2015; Faiella et al, 2015). Gamified designs and hence their impacts differ depending on the nature of the learning site, the subject matter, the instructor, and how gamification is to be implemented (Alsawaier, 2018). These contextual effects make the effectiveness of gamified learning hard to synthesize (Dicheva et al, 2015). Furthermore, the descriptive nature of most studies precludes inferential claims about the effectiveness of gamification despite the many reports of successful implementations (Hamari et al, 2014). In addition, gamification cannot be successfully implemented into the classroom without the support of a solid technological infrastructure and suitable pedagogical framework (*i.e.*, 'learning design elements'). A generalized description of effective gamification of learning is therefore elusive (Dicheva et al, 2015).

4.3.2. Learner characteristics

Another common aspect of the studies was that learner and content characteristics clearly determine the impact of gamification in education (Faiella et al, 2015; Kim et al, 2018). For example, student engagement has been found to be particularly improved if individuals are free to select a preferred mode of learning (Faiella et al, 2015). Additionally, students' previous exposure to video game elements, the number of games played, prior knowledge of, and exposure to gaming play an important role on the success of gamified experiences (Alsawaier, 2018; Garland, 2018; Kim et al, 2018; Mart-Parreo et al 2016). Despite some reports, effectiveness research has not been properly contextualized with regards to how particular kinds of learners are motivated in different gamified contexts or how personality traits like extroversion or introversion may impact the social aspects of a gamified experience.

In sum, gamification studies tend to overlook critical contextual moderators that help explain mixed results on effectiveness. For example, social dynamics may be moderated by personality traits like extroversion and responses to gamified instruction may vary as a result of students' preferences (Mart-Parreo et al, 2016). In light of the above, evidence is needed to corroborate practitioners' claims that newer, innovative formats can lead to better results with different demographics (Bell, 2017; Ortiz et al, 2016). To properly assess the impact of gamification, therefore, the field is in need of richer predictive models that include contextual variables as mediating or moderating variables, such as students' levels of motivation, personalities, and game preferences (Ortiz et al, 2016).

4.3.3. Biases

Literature reviews also make evident certain biases in the corpus of primary literature. Most notable and problematic is the evidence for a disproportionate interest in the benefits of gamification. Though not explicitly confirmed, this may indicate a publication bias, where only positive results are reported, either due to a disproportionate search for positive outcomes while ignoring negative outcomes, or due to the lack of interest in publishing negative results (file drawer bias). More studies should, therefore, include a focus on the possible negative outcomes of gamification, particularly with regard to students' emotions. Mart-Parreo et al (2016) found that studies largely fail to explore how gamification might cause frustration, anxiety, or negative social comparison. Similarly, de Marcos et al's (2017) study on social gamification reported decreased motivation and participation as the course progressed, probably due to the fact that the duration and timing were not taken into account during the design phase of the course.

Another contextual bias is evident in the preponderance of research focusing on computer science and IT (STEM) courses as opposed to other fields (Dicheva et al, 2015; Ortiz et al, 2016; Kim et al, 2018). This bias might be because implementation of gamification requires the set-up needed to integrate and envision game mechanisms and dynamics, which are usually found the computer science and IT department faculty (Dicheva et al, 2015). On the background of this bias, studies reveal that gamification produced better effects in these STEM subjects than the humanities (Kim et al, 2018). It is unclear if the application of gamification in other fields would result in the same findings.

5. Conclusions

Based on our second-order review, we offer recommendations for further research in the field, with the objective of better informing debates on the effectiveness of gamification in learning.

1. The relation between game design principles and game mechanics is important. Research studies and reviews would benefit from unpacking game design elements and explicitly considering which game mechanics are employed and in service of which game design principles.

2. The relation between game design elements and learning design elements is important. In addition to a clearer analysis of the game design elements employed in research studies, equally important in terms of outcomes is the consideration of 'learning design elements', or the pedagogical principles, learning objectives and learning activities that are gamified. Noticeable are the potential overlaps between the two sets of principles. For example, 'rapid feedback' is a both principle of game design and pedagogy, while 'levels' and 'access' align well with 'mastery learning' (see *e.g.*, Hattie, 2015), but mechanics do not overlap. This raises the enticing suggestion that gamification of learning is most effective when the principles of gaming and learning are shared, aligned or even equivalent and operationalized through game mechanics. Furthermore, the effectiveness of the learning activities that

are gamified seems a clear prerequisite to effectiveness of the gamification. Finally, not all types of learning objectives may be equally effectively gamified. More careful analysis of these factors will help understand what types of learning are effectively gamified.

3. Contextual variables are important. With a clearer view of the 'intervention' as defined in recommendations 1 and 2, a clearer view of the contextual models is called for.

4. Richer predictive models will help. Summing up the previous recommendations, predictive models that include the relations among game design elements, learning design elements and contextual variables will benefit our understanding of what is best gamified, how, for whom and to what end.

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