Gamification and Education: A Literature Review

Ilaria Caponetto, Jeffrey Earp and Michela Ott
ITD-CNR, Genova, Italy
caponetto@itd.cnr.it
jeff@itd.cnr.it
ott@itd.cnr.it

Abstract: The term "gamification" is generally used to denote the application of game mechanisms in non-gaming environments with the aim of enhancing the processes enacted and the experience of those involved. In recent years, gamification has become a catchword throughout the fields of education and training, thanks to its perceived potential to make learning more motivating and engaging. This paper is an attempt to shed light on the emergence and consolidation of gamification in education/training. It reports the results of a literature review that collected and analysed around 120 papers on the topic published between 2011 and 2014. These originate from different countries and deal with gamification both in training contexts and in formal educational, from primary school to higher education. The collected papers were analysed and classified according to various criteria, including target population, type of research (theoretical vs experimental), kind of educational contents delivered, and the tools deployed. The results that emerge from this study point to the increasing popularity of gamification techniques applied in a wide range of educational settings. At the same time, it appears that over the last few years the concept of gamification has become more clearly defined in the minds of researchers and practitioners. Indeed, until fairly recently the term was used by many to denote the adoption of game artefacts (especially digital ones) as educational tools for learning a specific subject such as algebra. In other words, it was used as a synonym of Game Based Learning (GBL) rather than to identify an educational strategy informing the overall learning process, which is treated globally as a game or competition. However, this terminological confusion appears only in a few isolated cases in this literature review, suggesting that a certain level of taxonomic and epistemological convergence is underway.

Keywords: gamification, serious games, game-based learning, technology enhanced learning, engagement, motivation

1. Introduction

Gamification appears to be an emerging trend in many sectors, including business, organizational management, in-service training, health, social policy, and education. The term refers to the "*use of game mechanics in non-gaming contexts*" (Deterding, Dixon, Khaled, & Nacke, 2011) or, rather, to "*the phenomenon of creating gameful experiences*" (Koivisto & Hamari, 2014). Gamification is adopted in different contexts and for a variety of purposes. It is used as a driver to promote fundamental things like learning, employee performance, customer engagement, and even crowdsourcing initiatives. According to Gartner Inc.[1], the widespread interest that gamification is attracting lies in its potential to strengthen engagement, change behaviours and support innovation. Indeed, an increasing number of services are presently being gamified (Huotari & Hamari, 2012), and Gartner predicts that by 2015 over half the organizations that deal with innovation processes will have gamified their activities to some extent. Gamification is also taking off in education (Domínguez, et al., 2013), due to the conviction that it supports and motivates students, and can thus lead to enhanced learning processes and outcomes (Kapp, 2012). Before the validity (or otherwise) of this conviction can be established, more understanding is needed of gamification within education, something which essentially entails the "*introduction of game elements in the design of learning processes*" (Bellotti, et al., 2013). To shed further light on gamified learning experiences, the authors recently conducted a literature search and review into the current relationship between gamification and education, the results of which are reported in this paper. It comes as little surprise that gamification is a hot topic in the academic community. A strong body of research work has already been generated and the number of new publications on gamification is growing daily, as underlined in a recent study (Hamari, Koivisto, & Sarsa, 2014). For our purposes, we focus on the literature specifically regarding gamification and education, which in itself comprises a significant number of written research works.

2. Process and sources

Our literature search and review was carried out in early 2014, following the fundamental methodological steps identified by Rickinson & May (2009): scoping, searching, selecting, analysing, synthesising and reporting. The first of these steps – scoping – culminated in definition of (a) the search string to be adopted, namely

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[1] http://www.gartner.com/newsroom/id/1629214

<*gamif**> (gamification, gamify, gamified, etc.) AND <*education* OR *learning* OR *training*>; (b) the latitude of the search (full-text); and (c) the time span of interest, i.e. scientific works published between 2000 and early 2014. To maximise coverage in the search step, channels of three different types were targeted: the Web (via the Google Scholar search engine), indexed databases of scientific publications (Web of Knowledge, Scopus), and also academia-driven social networks (ResearchGate, Academia.org).

When this first search was executed, a huge number of results was retrieved, almost three thousand deriving from Google Scholar alone. The need thus arose to reappraise the scope and search string in order to obtain a more selective, focused and usable data set. Accordingly, the latitude was adjusted, with *gamif** applied strictly to the publication title field, rather than to full-text. This meant that the papers selected for analysis would be those dealing with gamification as a core research concern, as opposed to those that simply mention the topic in passing for some reason. Table 1 below shows the number of records matching the above criteria that were retrieved from each of the adopted sources. Once duplicate titles were removed in the next selection step, a final list of 119 records emerged.

Table 1: total papers retrieved from each source

Data base	Number of results
Scopus	17
Web of Knowledge	12
Google Scholar	77
Academia.edu	13
Research Gate	32

3. Analysis of the data set

3.1 Time trends

This time span that was set in the scope phase of the literature search, namely the year 2000 onwards, was designed to include the moment in 2002 when the word gamification is held to have been coined (Marczewski, 2012). Surprisingly, it is not until 2011 that the term first appears in the title of papers dealing in some way with education. Figures 1 and 2 show the annual distribution of scientific writings covering "gamification and education". Firstly, Fig.1 shows the distribution for the data set generated according to the criteria described in Section 2 (*gamif** in title). In Fig.2 we see the annual distribution for the wider set of papers that mention both gamification and education, as retrieved from the Google Scholar search.

The totals in Fig.1 annual publication rates are 7 papers in 2011 (6% of the sample), 26 papers in 2012 (22%), and 79 in 2013 (66%). Only a small number of papers had appeared at the beginning of 2014 when the search was performed.
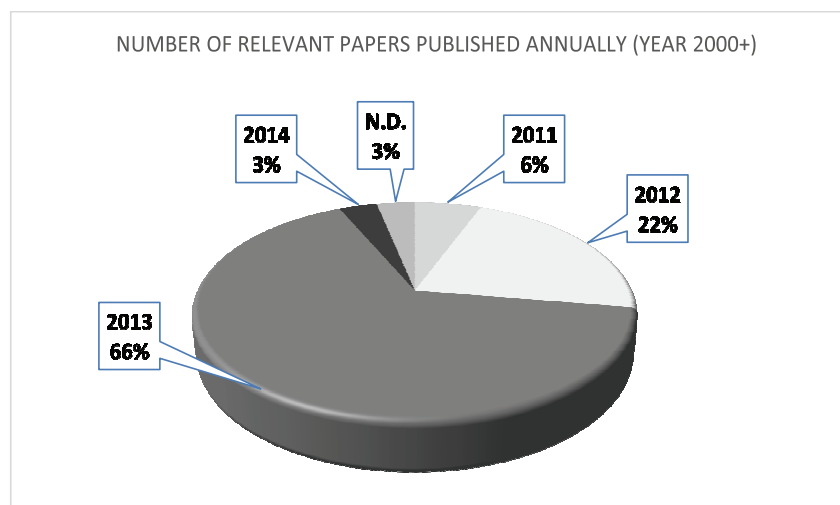

Figure 1: Annual distribution of relevant papers from 2011-2014

The rapid growth illustrated in Fig.1 was also confirmed in the search performed on Google Scholar to identify any scientific document dealing to some extent or other with both gamification and education. The partial

figures given for 2014 (half-year) are expected to increase further as the year progresses; they are included here simply to give an indication of the current trend.
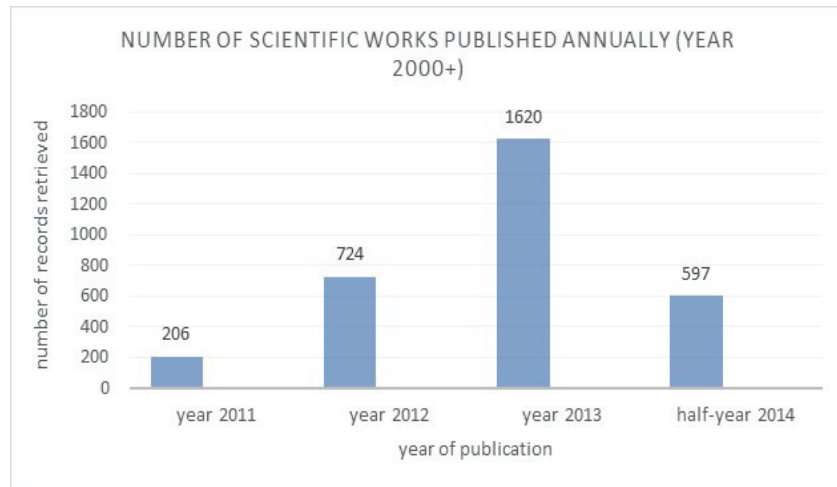

Figure 2: Annual distribution of papers mentioning gamification and education

These findings are in line with those reported by Hamari and colleagues (2014), who provide an overview of the rapid increase taking place in the publication of academic writings dealing with the general topic of gamification, i.e. not necessarily related to education.

3.2 Country of origin

Table 2 below provides a summary of the country of origin for the 119 papers in the sample. The results indicate that while gamification in education is understandably strong in its "birthplace", the USA (24% of the total), it is nonetheless an area of international interest in the education research community. The papers in the sample originated in a total of 25 different countries and no single country outside the USA was responsible for more than eight percent of the sample.

Table 2: Papers by country of origin

Country	Number of papers	Percentage of the total
USA	28	24%
Other (<3%)	22	18%
Canada	8	7%
Romania	8	7%
UK	8	7%
Spain	7	6%
Norway	5	4%
Portugal	5	4%
Australia	4	3%
Brazil	4	3%
Netherlands	4	3%
Poland	4	3%
Germany	3	3%
Greece	3	3%
Japan	3	3%
South Africa	3	3%
total	119	100%

4. Points for reflection

This section looks at some of the main points for reflection that emerged from the literature review we carried out.

What ideas and concepts are linked to the use of gamification in learning processes?

Figure 3 below shows the word cloud generated from all the words (around 14,000) contained in the abstracts of the 119 papers in the sample. Two verbs in the cloud caught our eye in particular: *increase* and *improve*. This would appear to demonstrate that gamification is linked in some way to added value in learning processes (Lee & Hammer, 2011). More detailed examination reveals that the terms *motivate / motivation* and *engage/ment* are frequently used. This confirms gamification's close relationship with learner engagement, as Muntean posits (Muntean, 2011), and with motivation, as Khaled postulates (Khaled, 2011). Indeed, these two concepts often appear in the definition of gamification itself (Groh, 2012). Close examination of the sample revealed that authors often make the link with these qualities by quoting the word – or drawing on the evidence – of others. In other words, rather than presenting fresh research work, many papers build on results from investigations or field experiments that others have conducted, possibly to confirm gamification's capacity to enhance students' motivation and engagement.

Other interesting words to emerge from the word cloud are "school" and "courses" reflecting the scope of the search, namely gamification in formal education. Two more frequent occurrences are "social" and "design". The former probably reflects the impact that the gamification of learning processes has at a social level, while the latter likely confirms the importance that design has in learning interventions and activities of all kind (Bottino, et al., 2008), especially in the case of innovative educational strategies such as gamification.

Figure 3: Word cloud derived from the abstracts of the papers in the sample

4.1.1   Is gamification mainly treated at a theoretical level and/or it is tested in empirical studies?

The sample was evenly split between conceptual/theoretical papers (51%) and empirical studies (49%). Furthermore, 39% provided statistical evidence gained from data collected in field experiments.

4.1.2   Is gamification of learning processes linked to specific target populations?

Our review showed that gamification is widely used in formal educational contexts, including K-12 and especially university courses (43%). Fig.4 below offers an interesting insight into the fact that many papers refer to training rather than to strictly "educational" situations. Within the 48% defined as "others", the vast majority refer to learning interventions carried out within companies for the purposes of in-service training, marketing, customer engagement, etc.

4.1.3   Are there clear boundaries between the concepts of game based learning (GBL) and gamification?

One of the objectives of this literature review was to shed light on what authors actually intended by the term gamification: the application of gaming mechanics / techniques and tools (such as badges, point scores and rewards) in non-game environments or, more loosely, the adoption of (serious) games in educational contexts. Fig. 5 shows that 75% of the papers use the term gamification in the former sense (the one given in this paper as the definition of the concept) to refer to situations in which the learning path in its entirety is treated as a globally "gamified" process. Only 9% of the sample used gamification as a synonym of GBL, i.e. the use of self-contained game artefacts deployed at some point in a learning path actuated in an educational context. A further 16% relate to cases where learner interaction with a Serious Game has been integrated to some extent within a global learning intervention that is gamified.
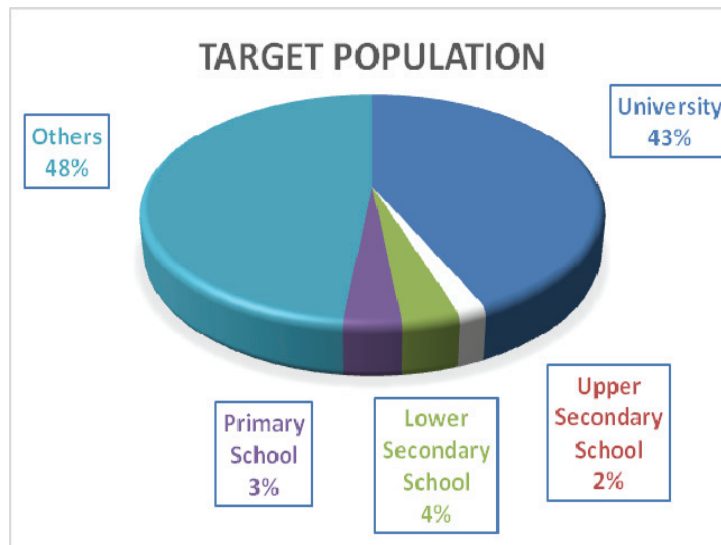
Figure 4: Distribution of gamification papers by target population

Figure 5: Use of the term "gamification" to denote gamification and GBL activities

An example of this last category is eSG[2], a research project in which the authors are involved. Co-funded by the EU under the Erasmus FEXI programme, eSG aims to stimulate the innovative and entrepreneurial mindsets of students and provide them with the basic skills and knowledge to set up and successfully run an enterprise. In this project, compete in teams to explore a range of topics and tackle learning activities organised in (difficulty) levels. They collect points for each course activity completed, aiming to raise their ranking on the course leaderboard so as to qualify for the final playoffs. This gamified course incorporates various types of activities performed both in class and at home, including:

▪ traditional lectures, in which teachers present topics related to entrepreneurship;

▪ talks by invited entrepreneurs, who present their experience in building and managing a company, and also speak about a particular entrepreneurship topic;

▪ serious gaming sessions, in which entrepreneurship-oriented games are played generally at home but preceded and followed by class briefings;

▪ home assignments such as writing a report and completing thematic questionnaires;

▪ team-based "playoffs", i.e. serious gaming tournaments held on the final day of the course.

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[2] http://www.esg-project.eu/

Clearly, in this project serious gaming is just one of various instructional strategies adopted, forming part of an overall gamified learning process (Bellotti, et al., 2013) (Bellotti, et al., 2012). In other words, this project instantiates a situation where Serious Games are part of a larger gamified intervention.

4.1.4 For what subject areas are gamification techniques principally adopted?

At first glance, the sample covers a wide range of subjects, such as science (Rouse, 2013), maths (Goehle, 2013), foreign languages (Danowska-Florczyk & Mostowski, 2012), cultural heritage (Gordillo, Gallego, Barra, & Quemada, 2013), health (Gabarron, Schopf, Serrano, Fernandez-Luque, & Dorronzoro, 2012), computer science (Li, Dong, Untch, & Chasteen, 2013), software engineering (Sheth, Bell, & Kaiser, 2012), business and logistics (Reiners, et al., 2012).

We also found that gamification techniques are adopted for very specific applied courses like graphic arts (Villagrasa & Duran, 2013) and gardening (Watson, Hancock, & Mandryk, 2013).

In-depth examination (particular of the papers reporting field experiments) also showed that while gamification techniques are adopted to support classroom learning of content in specific subject areas, they are also employed to pursue transversal objectives, such as fostering participatory approaches and collaboration among peers (Li, Dong, Untch, & Chasteen, 2013), self-guided learning (Watson, Hancock, & Mandryk, 2013), completion of homework assignments (Goehle, 2013), making assessment procedures easier and more effective (Moccozet, Tardy, Opprecht, & Léonard, 2013,), integration of exploratory approaches to learning (Gordillo, Gallego, Barra, & Quemada, 2013), and strengthening student creativity (Barata, Gama, Fonseca, & Gonçalves, 2013).

5. Conclusions

Analysis of the results from the literature review on gamification in formal education reported in this paper allows us, in synthesis, to confirm the following.

Gamification practices adopted to support learning processes enacted in the education and professional training sectors is a rapidly growing phenomenon.

The concepts of game-based learning and gamification (the former denoting the adoption of games for educational purposes and the latter the application of game mechanisms to educational interventions globally) remain sufficiently distinct, with interesting situations emerging in which the two practices coexist and nurture each other.

Enhancement of motivation and engagement in learning tasks (Ott & Tavella, 2009) is the main driver for adoption of gamification techniques, i.e. to make learning more attractive, captivating and, ultimately, effective.

Empirical studies of gamification initiatives have been carried out at different education levels, although there is a strong prevalence at university level.

Gamification techniques are being adopted to support learning in a variety of educational contexts and subject areas, but also to address transversal attitudes and behaviours such as collaboration, creativity, and self-guided study.

A further consideration worthy of note regards how gamification strategies were actually deployed in the work reported in the sample. We found that few interventions were based on blended modalities comprising both face-to-face and e-learning sessions. The majority were carried out online, with the whole intervention delivered through a Learning Management System (LMS) platform that featured functions design specifically to meet the needs of a gamified process, such as a leaderboard and distribution of achievement badges and rewards.

In addition, analysis of the sample pointed to general awareness of the need for careful planning and design of learning interventions (Olimpo, et al., 2010), especially where innovative educational approaches like gamification are involved.

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