

APPLYING GAMIFICATION IN LEARNING PROCESSES: GOOD PRACTICES AND RECOMMENDATIONS ABOUT HOW SERIOUS GAMES CAN ENHANCE STUDENTS' LEARNING SKILLS

LA GAMIFICATION NEI PROCESSI DI APPRENDIMENTO: BUONE PRATICHE E INDICAZIONI SULLA CAPACITÀ DEI SERIOUS GAMES DI MIGLIORARE LE CAPACITÀ DI APPRENDIMENTO DEGLI STUDENTI

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Abstract

This paper is a quantitative literary review about serious games (SGs). It investigates two main questions: Are SGs used by teachers in planning their teaching and learning processes? What are the strengths and weaknesses of the implementation of SGs in an educational process and environment? We investigated about 200 papers from different countries and selected 96 of them after reading the abstracts. We didn't choose a specific school grade or subject because the aim wasn't a qualitative analysis about the specific outcomes that the implementation of SGs can provide to a single subject or scientific aspect. The main purpose of the paper is the evaluation of the usefulness and suitability of SGs in various educational environments. The most predictable positive features emerging from the review are the positive effects of SGs on students' engagement in learning and learning outcomes and the positive feedbacks from teachers. The negative ones are the difficulty of using a SG outside of its unique educational environments, the resistance of some teachers, and the absence of SGs in less spoken languages. In the conclusions there is a reflection about the role Universities can have in the development of SGs and in creating a network among all the actors involved in this process.

Il presente lavoro è una quantitative review sui Serious Games (SGs). Le due domande di ricerca sono: gli insegnanti utilizzano i SGs nel progettare i processi di insegnamento e apprendimento? Quali sono i punti di forza e di debolezza dell'implementazione dei SGs in un processo ed ambiente di apprendimento? Abbiamo analizzato oltre 200 articoli da diversi Paesi e ne abbiamo selezionati 96 dopo la lettura degli abstracts. Non ci siamo focalizzati su un grado di scuola o materia specifici, perché

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L'obiettivo della ricerca non è stata un'analisi qualitativa dei risultati specifici che l'implementazione dei SGs possono portare ad una singola materia o settore scientifico. L'obiettivo principale del paper è una valutazione sull'utilità e sull'opportunità di utilizzare i SGs in diversi ambienti di apprendimento. I prevedibili aspetti positivi emersi dalla review sono gli effetti avuti dai SGs sui risultati dell'apprendimento degli studenti e sull'impegno profuso da questi, e i feedback dai docenti. Gli aspetti negativi sono la difficoltà di utilizzare un SG fuori dall'ambiente di apprendimento per il quale è stato progettato, la resistenza di alcuni insegnanti e l'assenza di SGs prodotti in lingue meno parlate. Nelle conclusioni proponiamo uno spunto di riflessione sul ruolo che le Università possono assumere nello sviluppo dei SGs e nella creazione di un network tra i diversi attori coinvolti nel processo.

Key-words

Serious Games, Teaching, Learning, Education
"Serious Game", insegnamento, apprendimento, istruzione

Introduction

In the last decade, the use of e-learning platforms and new innovative methodologies to support teaching has grown exponentially, all from a lifelong learning perspective (Rivoltella, 2020). New technologies have resulted in a change in the educational needs and requirements of learners.

Specifically, in the last five years, the world of education and training has begun to focus its interest in Edutainment, the use of Gamification strategies and, in particular, the use of Serious Games (SGs), in different learning environments. This is because the use of games plays an increasingly relevant role in the educational context and is becoming more and more widespread.

In light of these changes in perspective, two questions need to be asked: are teachers using SGs in planning teaching and learning processes? What are the strengths and weaknesses of implementing SGs in educational processes and environments?

1. Theoretical framework

The term "Edutainment", a neologism given by the union of the term "Educational" and "Entrainment", refers to new strategies and forms of communication that make learning processes more engaging and fun (Putra, 2018). The main goal is to combine real experience with classic formats related to education; it is associated with the new educational trends of the 21st century, which aim to be increasingly informal: this means that the learning process is not bound to school walls or institutions (Chilingaryan & Zvereva, 2020). This approach is student-centered, meaning that the student does not have a passive role in the learning process but rather an active one, as he or she is an active user of the learning experience and co-constructs knowledge and new skills while having fun.

According to Chilingaryan and Zvereva (2020) this approach implements two main tasks:

1. It allows to maintain students' interest and involvement;
2. The game provides opportunities to create direct experience. Training and skill development occur directly in the learning process.

With Edutainment activities, in fact, it is not only possible to foster new skills, new models but above all interdisciplinary approaches. Among the positive aspects of Edutainment are learning by doing, proactivity (understood as training to have an active approach to training), team work and peer education.

It is also necessary to remember that play in itself implies learning: it allows to experience roles, to grasp constituent traits of the culture in which each person lives, to manipulate materials and tools while exploring everyday contexts (Rivoltella & Rossi, 2019).

The world of Edutainment adds other potentials in the sense of a didactics oriented to meta-cognition - that is, the awareness of decision-making processes that take place while learning - and to the reflection on mental models.

Edutainment approaches include Gamification strategies and the use of Serious Games (SGs). The term Gamification was introduced for the first time in public in February 2010 by Jess Schell, a famous American game-designer, at the "*Dice Conference*" (dicesummit.org) in Las Vegas. In his speech, Jess Schell never explicitly mentions the word "Gamification" but in fact theorizes and defines this phenomenon for the first time, describing how gaming is increasingly destined to break out of the traditional boundaries of the console or PC and enter every moment of human life (Petruzzi, 2015).

Gamification can be understood as the use of elements borrowed from games and game design techniques in contexts outside of games (Sailer & Homner, 2020); the goal is to bring people to feel more involvement and fun in daily activities through the game, encouraging the active interest of users to modify their behavior data. From this statement, it is possible to deduce that a gamification strategy is successful only if it manages to affect not only users' habits, but also problem solving.

In addition, as stated by McGonigal (2011) the ludic component can facilitate the understanding of the current world and incite virtuous social behavior; games can serve to make better or more bearable those experiences that normally do not sufficiently gratify a person, giving a more epic meaning to the actions performed.

Gamification processes can be described by referring to three aspects, namely: the ludic mechanisms, the strategies and processes in which the ludic mechanisms are used and finally the context and its variables.

The ludic mechanisms of gamification take up a specific vision of play, the one related to challenge, rule-driven competition and a specific ludic tradition: that of video games. In this sense, some of the most established ludic mechanisms are (Rivoltella & Rossi, 2019):

- The score, which can constitute in educational terms, not a simple reinforcement but a form of feedback;
- Levels. The structuring in levels of video games makes possible forms of involvement and renewed and constant engagement on the part of the player. Levels are important because they allow the acquisition of awareness of the goals achieved and to be achieved as a motivating function.
- Rankings. Their use makes possible a comparison with other participants.
- Badges, often used in online activities. From a playful point of view they represent prizes of a competition, from an educational point of view and at the level of learning they are forms of certification of the achievement of a certain level of learning.

The ludic mechanisms of gamification require inclusion in processes driven by specific strategies, including (Rivoltella & Rossi, 2019):

- Flow. A game works insofar as it knows how to place itself at the point of balance between anxiety, generated by the perception of not being able to perform the task, and boredom.
- Alternating physical reality/virtual reality. Being able to joust not in terms of opposition but of mutual referral between physical and virtual reality is another modality already widely experimented in Alternated Reality Games (ARG).
- Narrative. The narrative dimension, although not present in all games, acquires a particular weight in gamification processes, especially with regard to learning. The narrative generates the essential meaning of the experience, avoiding the use of ludic mechanisms that can be reductive and uninvolved.

In addition, it is necessary to adapt gamification processes to contexts. Indeed, as in teaching processes, the interaction between those who participate and those who guide can be the difference between a successful experience and a path that is emotionally unrewarding and limited in terms of learning (Rivoltella & Rossi, 2019).

The concept of gamification often overlaps with that of Serious Games. In reality, they are two different elements with distinct characteristics between them.

A Serious Game is an actual game but designed with a specific purpose other than mere entertainment (Dimitriadou et al., 2021). In Serious Games the serious and playful aspects are balanced. In this case the principle of "learning by doing" is added to the playful and entertaining aspect. This makes the training much more effective and efficient.

SGs allow for the active involvement of the student, which is fundamental to achieve greater results in terms of effectiveness and goal attainment; as Barbieri and colleagues (2021) state, in fact, experiential learning has a particular importance, since the information and sensations experienced in first person remain strongly imprinted and allow the player (the student, therefore) to refine perception, attention and memory by promoting behavioral changes through learning. Using SGs in the classroom has many advantages. First and foremost, the teacher is able to provide a safe and controlled environment for learners by eliciting enthusiasm and engagement (Balducci, 2018). In addition, SGs give the opportunity to receive immediate feedback, allowing the subject to focus on the error and repeat the game countless times; all this allows to achieve total mastery of the dynamics "explored", increasing the serenity with which the tool is used and with which the real situation will be addressed (Barbieri et al., 2021). Despite the countless advantages of using SGs in formal settings, many teachers remain skeptical about their use. The same skepticism is the result of a lack of digital literacy among teachers, who are unable to implement this methodology in their classrooms because they don't have the right skills. Consequently, the purpose of this article is to investigate about the use of SGs, by teachers, in planning teaching and learning processes and to analyze the strengths and weaknesses of SGs implementation in educational processes and environments.

2. Methods and materials

As above mentioned, this work is the first step that our research team is making into the scientific research about SGs. This is the reason why the research does not focus on a single or specific target of the studies, on a specific school subject or on a specific school grade. The main aim was to obtain a preliminary overview about the types of studies about SGs conducted

by the scientific academic community, in order to understand the trends of the most recent and ongoing studies and then set up our research criteria in a more specific way of which will be discussed in the Conclusions.

For this reason, the first step was to look for the most recent papers findable through a research on Scopus, selecting the period 2016-2022 (Fig. 1).

DATABASE	KEYWORDS	TIMEFRAME
Scopus	Serious Games Teaching Learning Education	From 2016 to 2022

Figure 1 (research criteria)

Once the search engine has been selected, the period in which to search was set from 2016 to the present day.

Considering the choice of criteria on which not to focus, the next step was the decision about the keywords to use in order to start the research.

Of course, the first keyword had to be “Serious Games”, the very main topic of the research field to which this work refers to; the following keywords were decided on the basis of the research field of the team, which is currently engaged on teaching and learning processes, teachers’ training in ICT and the repercussions the training will have on students’ learning.

Since the very aim of this work was not to make a research on a specific aspect of the SGs field, the choice fell on very generic keywords, that were “teaching”, “learning” and “education”.

The research made with the criteria in Fig. X provided more than 200 results, a number that was largely expected looking at the spread of the interest about SGs in the last years (quote).

Being aware of having used generic keywords, the second step of the research was reading the abstract of the resulting papers, in order to understand which papers were actually related to our research goals and which were not. There were prior eliminated the quantitative reviews, reducing the number of papers to 140. Then, the papers were read in their entirety, in order to clarify if they were relevance to the research goals or not. The result was another skimming, limiting the number of relevant papers to 96.

Reading these 96 papers, they were divided according to the three marco-themes that emerged (Tab. 1):

- use and implementation of a Serious Game (65);
- evaluation on the use of a Serious Game (10);
- general use of edutainment approach (21)

Use and implementation of a Serious Game

[1], [4], [5], [10], [11], [14], [15], [16], [17], [18], [19], [20], [21], [23], [26], [27], [28], [32], [33], [34], [35], [36], [37], [41], [42], [43], [44], [45], [46], [48], [49], [51], [53], [54], [56], [59], [61], [62], [63], [64], [65], [66], [67], [68], [69],

	[72], [73], [75], [77], [78], [79], [80], [81], [83], [84], [85], [86], [87], [88], [90], [92], [93], [94], [95], [96]
Evaluation on the use of a Serious Game	[9], [12], [22], [24], [25], [29], [38], [39], [40], [47], [50], [55], [57], [58], [60], [70], [71], [76], [82], [89], [91]
General use of edutainment approach	[2], [3], [6], [7], [8], [13], [30], [31], [52], [74]

Table 1 (macro-themes division)

Based on this first division, the research focused on the analysis of the experiments and experiences found in the papers, in order to look for the good practices in the planning, creation, selection, practical use and experimentation of the SGs in the various learning and/or working environments we found in the papers.

Even though it was not a research criterion, we want to highlight the target to which the papers are addressed (Tab. 2).

Teachers	[6], [9], [10], [13], [14], [21], [24], [25], [30], [31], [34], [40], [45], [50], [51], [52], [54], [55], [57], [59], [67], [70], [72], [76]
Students	[1], [5], [11], [12], [15], [18], [19], [20], [22], [23], [26], [27], [28], [32], [35], [37], [38], [41], [42], [43], [46], [47], [48], [49], [53], [58], [61], [62], [63], [64], [65], [66], [68], [73], [75], [77], [78], [79], [88], [89], [90], [91]
Teachers and students	[29], [33], [39], [56]
Designers	[2], [3], [4], [7], [8], [60], [69], [74]
Teachers and designers	[16], [71]
Students and designers	[17], [36], [80]
Citizens	[81], [82], [83], [84], [85], [86], [87], [92], [93], [94], [95], [96]
Missing target	[44]

Table 2 (target of the papers analyzed)

Teachers (24) and students (42) are the actors more involved in the studies, even more considering the papers with more than one target (75 out of 96). Designers and citizens (by citizens we mean that the paper refers to a target not identifiable with students) are the minority target, but they are still well considered in the studies (1 out of 4).

In the following steps, the research focused on the strengths and weaknesses of the use and implementation of the SGs and the results of the test phases and the methods used to evaluate these results.

4. Results

The reading and analyses of the 96 papers led to the individuation of data on:

- the types of studied conducted (Tab. 3);
- the sample population involved in the test phases (Tab. 4)
- the methodologies used to evaluate the test results in the various experiments and experiences (Tab. 5)

As the Tab. 3 shows, some of the paper investigated do not provide a test phase (33). However, excluding the reviews on the SGs literacy (9), the main topic is still the use and implementation of a SG although it hasn't been tested with people but only in laboratory or doesn't present a test at all (24). Instead, the papers with a test phase (63) have been analyzed in a more specific way.

Implementation of SG and test phase	[1], [3], [4], [5], [10], [11], [14], [15], [17], [18], [19], [20], [22], [24], [26], [27], [28], [29], [32], [33], [34], [35], [37], [38], [41], [46], [47], [48], [49], [50], [51], [52], [53], [55], [56], [58], [59], [60], [61], [63], [65], [67], [68], [69], [71], [72], [73], [74], [75], [76], [78], [79], [80], [81], [83], [85], [87], [88], [89], [90], [91], [92], [93]
SG prototypes not tested or tested only in laboratory	[8], [9], [12], [21], [23], [25], [30], [31], [36], [39], [40], [42], [54], [57], [62], [64], [66], [70], [77], [84], [86], [94], [95], [96]
Literacy reviews	[2], [6], [7], [13], [16], [43], [44], [45], [82]

Table 3 (types of study conducted)

Dealing with the papers with the test phase, the research underlines the number of people considered as sample population (Tab. X): it varies from less than ten people (4) to more than 400 (6).

1 – 9	[32], [46], [50], [58]
10 – 19	[33], [51], [56], [61], [73]
20 – 49	[17], [38], [41], [65], [79], [87]
50 – 99	[1], [63], [67], [68], [72], [75], [78], [80], [88], [89], [90], [91], [94]
100 – 200	[5], [15], [18], [19], [22], [24], [28], [29], [34], [37]
200 – 400	[20], [26], [47], [85]
+400	[11], [27], [35], [48], [81], [92]

Table 4 (sample population)

Another important feature for this research is the evaluation methodologies used to collect and assess the results of the test phase. As Tab. 5 shows, the methodology selected is not univocal:

Quantitative	[3], [4], [5], [10], [14], [20], [27], [29], [47], [48], [51], [55], [56], [58], [63], [67], [72], [74], [78], [80], [81], [85], [87], [88]
Qualitative	[1], [17], [24], [26], [32], [33], [35], [37], [38], [46], [50], [65], [69], [75], [90], [91]
Quantitative & qualitative	[11], [15], [18], [28], [34], [41], [61], [68], [73], [76], [79], [83], [89]
Evaluation method specific of the SG	[19], [22], [49], [93]
Proposal of an evaluation method	[52], [53], [59], [60], [71], [92]

Table 5 (evaluation methodologies found in the 63 papers with test phase)

Quantitative (24) and qualitative (16) methodologies are the most used, although there is a good number of a mixed method involving both of them (13).

It is interesting to see that there are some evaluation methods really specific for some of the SGs investigated (4) and that some papers propose a new evaluation method for SGs (6).

A fact that emerges from the analysis of the Tab. 2-5 and that cannot be ignored is the extreme heterogeneity of the results. It is not possible to identify a research prototype based on the results emerged from this research: although the majority of the papers present a test phase, the target of the papers, the numerosity of the sample population and the evaluation method differ greatly from each other.

5. Discussion

The heterogeneity that emerges from the quantitative results is confirmed by reading the reflections and considerations written by the authors in the abstracts and conclusions of the papers themselves.

In most of the papers the SGs are projected and designed for very specific learning environments, skills, scenarios and or case studies. The word “specific” itself, referred to scenarios, environments or skills to be acquired in a single subject it is already used in 22 abstracts.

This characteristic leads to the impossibility of generalizing any results, whether they are qualitative or quantitative. The effects of the implementation of SGs or use of edutainment detected in the papers have been obtained in specific sets, sometimes one classroom or less. This methodology does not provide any certainty about the repurposing of the study in a different environment, even though the various studies appear easily replicable, considering that more than a half (29 out of 49) of the test conducted with people were aimed at less than 100 persons.

As shown in Tab. 2 the target considered by the papers is also heterogeneous, although teachers (24) and students (42) are the actors more involved in the studies, even more considering the paper with more than one target (75 out of 96). The motivation is easily imaginable: these are the actors that are going to use SGs in their everyday life, both in planning the didactical goals of the teaching process as well as in practically using them in the teaching and learning processes. Designers and citizens (by citizens we mean that the paper refers to a target not identifiable with students) are the minority target, but they are still well considered in the studies (1 out of 4).

Consistently with what has been noted so far, the evaluation methodologies for the test phases are heterogeneous (Tab. 5) and sometimes very specific. The research does not identify a standard or a most suitable method to evaluate data collected in the various SGs' studies, indeed it is detectable a trend going towards a specific and unique evaluation method for each SG presented in the papers.

This seems to lead to the same reflection emerged in the analysis of the previous features: there is a total lack of the possibility to generalize the results provided by an evaluation method so specific. Moreover, the goal of some papers ([52], [53], [59], [60], [71], [92]) is the proposal of a new evaluation method which should be specific for SGs tests.

After having analyzed the technical characteristics of the studies taken into consideration, the research revealed two aspects and theme that appear very marginal or are not much considered among those identified in the analyzed papers. We want to underline two missing aspects: (1) the language, that could contribute to making SGs replicable, and (2) the absence of generic SGs for atypical people.

For the (1), the research found papers that do not focus about a particular language because they are about the development of SGs whose goal is to teach computational language and or computing skills (Valencia, 2017). While there are examples of SGs to teach foreign languages, especially English (Khatoony, 2019) but also in different Countries (Yamato et al., 2017), the research did not find experience of SGs produced in less spoken native languages (Hulusic & Pistoljevic, 2017) or translated in different languages that can be used in contexts with same characteristics but in different Countries. Some good practices of SGs produced in more languages are findable in SGs designed in European projects financed by the EU Commission, because the projects are realized among consortium of more Countries, so the SG must present several translations (Dell'Aquila et al., 2017; Marocco et al., 2019;).

If the aspect (1) is easily fixable integrating different languages, the aspect (2) does not have a quick fix. Of course, thinking about and design SGs for students with atypical development or impairments requires a very specific job, that needs people with psychological, sociological and cognitive science competences about atypical development (Pistoljevic & Hulusic, 2019), as well as the computational skills and competences to practically design and realize the SG, in order to present contents that can really help atypical students in their learning processes.

As mentioned before, the research found some examples of SGs for atypical students, but they are even more specific than the SGs this paper talks about at the beginning of this paragraph: the research found SG to teach reading skills to ASD children, but it is tested with only 9 children (Gomez et al., 2018), and some mini-games for children with visual impairments that provides guidelines without experimental data (Rodà et al., 2021).

6. Conclusions

The research presented in this paper have underlined some very interesting aspects about the researches about SGs conducted in the last 6 years and about the SGs produced and tested themselves.

The post tests and interviews conducted in the papers with a test phase shows a positive effect of SGs in enhancing students' motivation in teaching and learning processes, because SGs provide some fun in a process whose primary aim is not having fun, even in the very few data the research collected about teaching to children with atypical development (Tsikinas et al., 2018; Xinohalos & Tsikinas, 2019).

Since it's a relatively young tool, teachers need to be informed and trained about SGs, in order to overcome longstanding prejudices about games and videogames as a waste of time instead of studying (Kaimara et al., 2021; Assaf et al., 2021).

In order to overcome these prejudices, there should be a very cooperative work between academic institutions, which carry on researches about and develop SGs, designers of SGs and teachers as final users of this tool: teachers are the actors who know better than any other actor of the SGs designing process what the students need, and they are the only ones who can choose the right SG for the right learning purpose in their specific context and learning environments. Some experiments in sharing for designers and teachers have been done, like the IOLAOS platform (Vidakis & Charitakis, 2018), but Academic Institutions and Universities should present themselves as the strong and reliable players they are in order to fulfill the role of collector of skills and experiences that this research detect as missing.

Institutions and Universities have the expertise and experience in sharing competences that is needed to satisfy this lack. They can bring together designer and teachers by promoting training courses about SGs to teachers, in order to allow a wider and better implementation of SGs and a constant link and dialogue among all the actors involved in the development, creation and use of SGs; another goal for Universities could be the creation of a shared database of SGs research experiences, in order to foster cooperation about this theme and give better and better quality to research and development of SGs.

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