

Gamification Aspects in Detail: Collectanea of Studies to Renew Traditional Education

Isabela N. Cavaco¹, Livia de S. Barreto¹, Alanna C. C. Monteiro¹, Danielle Rousy Dias da Silva¹, Carla Silva²

¹Informatic Center – Federal University of Paraiba (UFPB)
CEP 58051-900 – Joao Pessoa – PB – Brazil

²Informatic Center – Federal University of Pernambuco (UFPE)
CEP 50740-560 – Recife – PE – Brazil

{isabela.nascimento, livia93.sousa, danielle.rousy}@gmail.com,
alannacoelho@hotmail.com, ctlls@cin.ufpe.br

Abstract. *This work's objective is to present the results of a systematic mapping that explored gamification in education to find good practices and lessons learned. There were identified a set of positive and negative aspects and tools to be reused by who wishes to use gamification to motivate students and to verify the effects of this technique. The results indicated the best practices and showed that, despite being very recent, gamification has already gained attention in many countries. In addition, gamification is overall effective and well received in education, attempting to the importance of planning the gamification design, the dynamic between groups and the participation of the teacher in the motivation and engagement of students.*

1. Introduction

Education has been through many changes, the insertion of technology amongst them, and has continuously searched to maintain students motivated and engaged, transforming how content is taught in class. Education must keep reinventing itself, for as stated by Bitencourt (2014), it is necessary to find solutions or alternatives that disrupts the process of learning and for the student to own the technology domain in the access and production of content. An alternative that comes to accomplish this proposal is the use of gamification [Bitencourt 2014].

Gamification is used to describe the use of game design elements in non-game contexts to improve the experience and engagement [Deterding et al., 2011; McCallum, 2012]. Gamification consists, according to Werbach and Hunter (2012), of puzzle pieces a game designer¹ utilizes to create an attractive experience in game.

One of the first contexts of the use of gamification was in business. Conforming Bunchball (2010), gamification in the commercial context is the process of integrating game components to a website, business service, online community, portals or marketing campaigns to enhance participation and engagement. Examples of gamification found in this context are Nike+², Foursquare³, Habitica⁴, Intuit Mint⁵, Super Better⁶, among others.

¹ *Game designer* is the professional that studies game theories to conceive a game with desirable interactions.

² <http://www.nikeplus.com.br/>

As reported by Hamari *et al.* (2014) and Kapp (2012), despite the predominant body of research and development of gamification being in the sector of business, due to commercial success and simplicity of application, gamification is growing also in the educational environment.

Despite the existence of other systematic mappings approaching concepts, such as the identification of gamification elements, the findings have not yet been sufficient to identify the best practices and lessons learned that would be important to those interested in gamifying. Based in this lack of information, this paper proposes a complementary mapping to the existing ones such as Boerges *et al.* (2013) and Dicheva *et al.* (2015), seeking to identify the strong and weak aspects, and to go further than limiting which elements are already used. In addition, some information are missing in the existing relevant studies regarding the teacher's role as an active agent in the process of gamifying education. Thus, it's important not only to recognize what are the potential game elements to improve engagement, but also to discover how to actually apply them and what situations are the most adequate to do so.

To investigate the uses and benefits of gamification in education, a systematic mapping was performed to gather further information, such as good practices, lessons learned, positive and negative aspects and the gamified tools. This information allow others to reuse and apply gamification as an alternative means to engage students and to verify its affect in education.

The second section of the paper presents gamification. The third section presents the systematic mapping. The fourth section presents and discuss the obtained results. The fifth section presents the main results. The sixth section presents the conclusion.

2. Gamification

“The potential of gamification is in the engagement and motivation of those who use it, which explains the constant growth of interest for the area” [KAPP, 2012]. Gamification, conforming Zichermann (2011), is characterized by the inclusion of electronic game mechanics, style, thinking and/or techniques to involve people in problem solving. Yet, in consonance with Deterding and others (2011), gamification is the addition of game elements in non-game contexts such as productivity, finances, health care, education, sustainability and others, to improve user experience and engagement.

Gamification is composed by two parts: game dynamics and game mechanics. Game dynamics, as reported by Werbach and Hunter (2012), are the most abstract game elements, and some examples highlighted by the authors are shown in Table 1.

Game mechanics, in turn, refers to the mechanisms used by designers to reward activities between users [Gamification Wiki 2015].

³ <https://foursquare.com/>

⁴ <https://habitica.com/>

⁵ <https://www.mint.com/>

⁶ <https://www.superbetter.com/>

Table 1. Game Dynamics

Game Dynamic	Definition
Emotions	Emotions influences people to keep using the system.
Narrative	Makes the experience consistent, giving the sensation of change and progress, referring to types of practices or ideas that gives context according to the objectives.
Progression	Gives the sensation of improvement, and the opportunity to progress to a more experienced state.
Relationships	Social interactions among colleagues and friends.

Conforming Werbach and Hunter (2012), the mechanics are the basic processes that leads to game action and generates engagement by the user. Some game mechanics mentioned by them are shown in Table 2.

Table 2. Game Mechanics

Game Mechanic	Definition
Rewards	Benefits given to users for completing some actions, like challenges. Simple actions can also reward to maintain engagement with the experience.
Challenges	Objectives with a greater difficulty level, and generally with more gratifying rewards.
Feedback	The results and performance of the experience are visible to the user, who wishes to maintain or improve during the activities.
Competition	Competition motivates users to improve their performance with the goal to outstand others.

Game components are specific instantiations of game dynamic and mechanics. Werbach and Hunter (2012) also exemplifies some game components shown in Table 3.

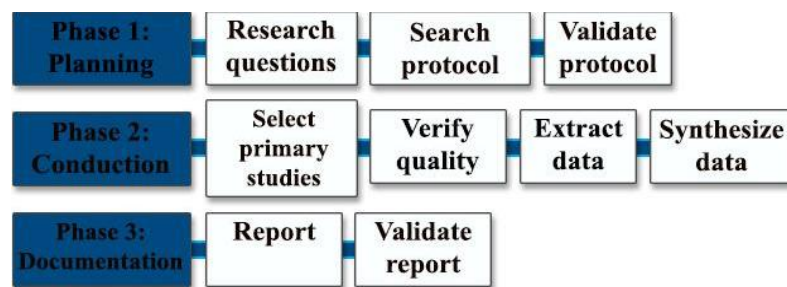
Table 3. Game Components

Game Component	Definition
Achievements	Mark the accomplishments of the users. In general, unlock a title, “Expert Programmer” for example, by completing determined challenge or activity a given amount of times.
Badges	Graphic representations of accomplishments. Like achievements, badges mark user’s accomplishments with trophies. Both are instantiations of the game mechanic “Rewards”.
Leaderboard	Associated to the game mechanics “Competition” and “Feedback”, allows the visualization of the user’s general situation compared to others.
Points	Points given by some activities and actions to mark progress and lead to level advance, which is associated to the game dynamic of “Progression”.

3. Systematic Mapping

This work presents the results of a research conducted in the form of a systematic review based on the proposed by Kitchenham (2004), who formalized the process as a way to identify, evaluate and interpret all available research relevant to a particular research question, topic area or phenomenon of interest. The author also defines as primary studies the individual studies that contributes to a systematic review, whilst secondary studies are in the form of a systematic review.

The process of mapping follows three main phases shown in picture one bellow: Planning, Conduction and Documentation.



Picture 1. Phases of the systematic mapping

3.1. Research Questions

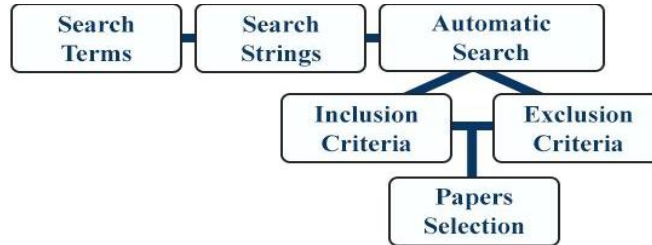
The research questions established for the context of this work were:

- Q1. What are the motives/objectives to gamify?
- Q2. What is the context of the use of gamification, in terms of target audience, location and knowledge field?
- Q3. What is the proposal of the study?
- Q4. What references the authors used to base their proposals?
- Q5. What are the positive and negative aspects found from the gamified development?
- Q6. How mature is the study, in terms of development, evaluation and time applied to the proposal?
- Q7. How the student's development was evaluated in terms of learning based on the gamified experience?
- Q8. What elements were used in the gamification?
- Q9. How was the balancing of gamified activities in terms of grade?
- Q10. What are the results obtained from the gamified experience?
- Q11. What tools were used to apply gamification?
- Q12. What is the relevance of the proposal to the development of the gamification guide?
- Q13. What observations can be withdrawn from the study?

In this work, for limitation reasons, some questions will not be addressed in the result section. Although, all results and more information about this mapping can be found in the complete report by Rousy and others (2015).

3.2. Search Protocol

The search protocol details the planning of the mapping, specifying the process to be followed for the selection of the papers and the conditions to be applied when those are selected [Brereton et al., 2007]. Picture 2 illustrates the steps defined by the protocol to perform the search and validate primary studies.



Picture 2. Steps to search, select and validate primary studies

3.2.1. Search Terms

The search terms were chosen considering key words and synonyms that could return the most relevant results during the automatic search in the electronic databases. Table 4 presents the terms used during this first step of the search.

Table 4. Search Terms

Search Terms	Definition
Gamification	Technique of using game elements in non-game contexts.
Guide	Indication of procedures to determine a course of action.
Learning	The act or process of acquiring knowledge or skill.
Studying	Synonym of "Learning"
Educational Process	Process of teaching something to others.
Educational Application	A computer program designed for education purposes.
Educational Software	Synonym of "Educational Application".

3.2.2. Search Strings

In the process of composing the search string, the main terms were joined through the boolean operator "AND", and secondary terms were included with "OR". The generic string defined and adapted between the search databases was:

(Title:gamification) and (Title:guideline or Title:learning or Title:"educational process" or Title:"educational application" or Title:"educational software" or Title:studying)

3.2.2. Automatic Search

The search process was executed in digital libraries, using defined search strings to proceed with the automatic search. The consulted libraries were ACM⁷, IEEE⁸, Google Scholar⁹ e Scopus¹⁰. The library Springer¹¹ was removed from this process for lack of unrestricted access to their database.

3.2.3. Inclusion and Exclusion Criteria

The selection of papers followed the inclusion and exclusion criteria shown in Table 5.

Table 5. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Papers in English or Portuguese	Papers with less than two pages
Papers that matched the search string	Papers that used or proposed games in education, known as serious games, used in another technique called Game Based Learning
Papers published within the past 5 years (2010 - 2015)	Papers that are not related to education
	Papers with “e-learning” in their title and/or abstract
	Secondary studies
	Papers unavailable for download or reading
	Book papers or duplicate papers

3.2.5. Papers Selection

The papers returned by the search string accounted for 168 in total, and their titles were registered in a spreadsheet for each researcher. The selection followed the researchers' individual judgement about the fulfillment of the criteria. Papers that matched any exclusion criteria were marked with the excluding criteria, and papers in conflict among the researchers were resolved by a third researcher, resulting in 85 papers left. From these 85, 52 were read, for 33 were unavailable for reading. During the reading, both criteria were observed once more, and by the end of this process, only 20 papers fulfilled every inclusion criteria. Table 6 presents the quantitative by search library during the process of papers selection.

4. Results

The result obtained through the studies' analysis reveals the growing interest for the application of gamification in education, with questions that aimed at reaching the context to which the studies belonged, besides classifying the data and finding

⁷ <http://portal.acm.org>

⁸ <http://ieeexplore.ieee.org>

⁹ <https://scholar.google.com.br>

¹⁰ <http://www.scopus.com>

¹¹ <http://www.springer.com>

expressive results about the use of gamification in the educational context. Some questions were essential to comprehending the real impact of the application of gamification in education, besides the common questions addressed in other systematic

Table 6. Studies by search library and final selection after criteria enforcements

Papers Selection	Amount
ACM Digital Library	6
IEEE Xplore	52
Google Scholar	69
Scopus	41
Total	168
After applying both criteria	52
Final Selection (after reading and applying both criteria)	20

mappings, such as objectives for gamifying, elements used, methodology and results, and in special, these questions addressed:

- Positive and negative aspects of each experience;
- Collectanea of tools used;
- References used by the studies as base for gamifying;
- Balancing of gamified activities;
- Comparison of results from each study with the accomplishment of the objectives.

To understand the relevance of each study results, and to give more credibility in the construction of the gamification guide regarding education, the studies were classified in terms of relevance: low, average and high. The relevance considered the maturity of each proposal, that varied with the existence of development and evaluation, and the time each study used to perform both. Analyzing these aspects it was found that 75% of the studies propose, develop and evaluate; 5% propose and develop and 20% only propose. In respect to the development time, the studies varied: some proposals didn't answer this question, lacking how long they worked with the target audience to ensure the effectiveness of their study; others were in continuous development and for that, their time was still undetermined; and those that varied their development time in an average time of 2 years, 1 year, 6 months, 3 months, 1 month and 1 week. The time is relevant to determine the credibility of the results, for those that developed their experiments in 2 years had more credibility than those that developed in just 1 week.

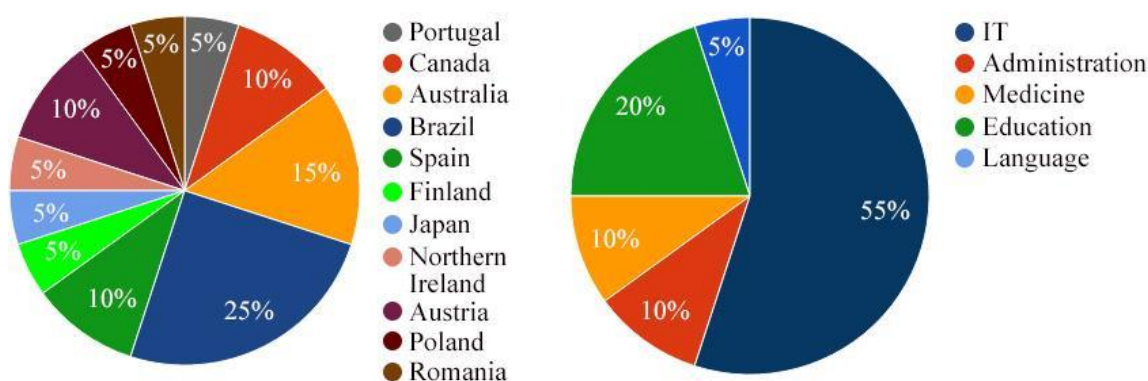
In the perspective of understanding the background of gamification, the main references used by the studies to originate ideas regarding each gamification proposal were observed (reference research question four). Some of the base references found are:

- The 8 types of gamification proposed by Marczewski (2013);
- Bartle's type of players
- RAMP intrinsic motivation model, both seen in the study of Herbert et al (2014);

- The statement of Gee (2003) that good video-games are machines for the learning process;
- Daniel J. Dubois' research, he focuses not only in gamification but also in the understanding of the mechanism of software development, where he states that experiments indicate that the integration of gamification in the software development process is relatively easy, but developing a gamified method and foreseeing the effects is much harder.

Still related to the background, the target audience, location and knowledge field were observed, for they are important information to determine what better works for a specific study case. The target audience found in general was in graduation (65%), education in general (25%), elementary school (5%) and technical course (5%). The studies were realized in many countries, what evidences the growth of studies that aim to motivate students and improve education through gamification from all around the world.

In respect to the context in education, the knowledge fields that applied gamification are shown in Graphic 1, where the category Education embraced studies that targeted education in general and elementary school. The category IT (Information Technology) embraced the areas related to technology: Computer Science, Engineering, Network and Multimedia Production. In Computer Science, some subjects and concepts gamified include programming in C (Programming Language), Web development, Game development and Software development. IT is the area that mostly used gamification, which may be explained by the fact that gamification is closer to the area, in terms of concepts, and also for the greater ease in implementing new and specific tools (reference to research question two).



Graphic 1. Location of the studies and knowledge fields

The research also focused on finding the purposes and objectives the studies aimed at reaching by using gamification. For instance, what promoted the study to use gamification, what was under investigation and what goal was expected to be accomplished (reference to research question one). Table 7 presents a general classification of the objectives for gamifying education and the studies that aimed at each, some having more than one objective. The most frequent objectives being: investigate the effects of gamification, improve student's learning motivation and verify if gamification succeeds at motivating students in learning.

Analyzing the studies under the perspective of how the student's development was evaluated in terms of learning based on the gamified items, 35% didn't develop

their proposals or didn't evaluate the development. The other 75% reported their evaluation, based on the use of surveys (reference to question ten of the research). As observed in the study of Hakulinen et al. (2014), to evaluate the development of students, voluntary questionnaires were used between different groups based on their objectives. In Luma (2014), to investigate the gamification as a strategy in the of students, different data collection techniques were used, such as observation, semi-structured interview and questionnaire.

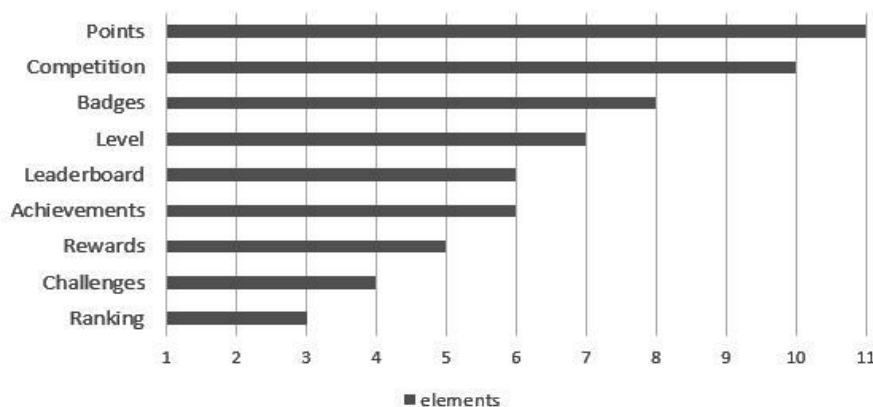
Table 7. Studies and objectives related

Motivation / Objectives	Studies related	Total
Investigate the effects of gamification	Barata et al., 2013; Sepehr et. al., 2013; Smith et. al., 2013; Ibanez et. al., 2014; Hakulinen et. al., 2014; Herbert et. al., 2014; Akpolat et. al., 2014; Erenli, 2012; Luma et. al., 2014; Laskowski, 2015; Paisley, 2013; Rughiniş, 2013; Bitencourt, 2014;	65%
Verify improvement in education quality	Barata et al., 2013; Herbert et. al., 2014; Rojas et al., 2014; Laskowski, 2015;	20%
Improve student's learning motivation	Cheong et al., 2013; Falcão et al., 2014; Herbert et. al., 2014; Leffa, 2014; Luma et. al., 2014; Rojas et al., 2014; Bitencourt, 2014;	35%
Simulate activities	Carvalho et al., 2013; Rojas et al., 2014;	10%
Engage students in the use of online tools	Smith et al., 2013; Ohno et al., 2013; Rojas et al., 2014;	15%
Search what motivates different types of student	Hakulinen et. al., 2014; Herbert et. al., 2014;	10%
Demonstrate scenarios for academic gamification	Erenli, 2012; Laskowski, 2015;	10%
Seek innovations in education's dynamic	Laskowski, 2015; González e Area, 2013; Bitencourt, 2014;	15%
Gamify learning materials	González e Area, 2013;	5%
Verify if gamification succeeds at motivating students in learning	Falcão et al., 2014; Ibanez et. al., 2014; Ohno et al., 2013; Akpolat et. al., 2014; Luma et. al., 2014; Paisley, 2013;	30%

Related to gamification elements, various game components used were synthesized in Graphic 2. It is possible to observe the most used elements: points, competition, badges, level, leaderboard, accomplishments, rewards, challenges and ranking; and so they are considered as classic elements when a gamification application is considered (reference to research question eight).

In reference to research question nine, only two studies related their experience in balancing their gamified activities. The study of Barata et al. (2013), which has inspired the interest for this question, describes that in the first year of the study, the activities corresponded from 10 to 15% of the final grade, but the feedback from the students revealed that the efforts to accomplish challenges, collect achievements and others weren't worth the total grade that could be obtained in this modality. The feedback was accepted and in the second year, the total grade for this modality was equivalent to 20% of the final grade. The other study is from Bitencourt (2014), where

students started the semester with an average grade of 7.0, pre-approved, resembles the game aspect of “lives” that, during the experience, can be lost or gained, each equivalent to 1 point in the final grade. Not performing activities and recurring faults costed points and to maintain the grade all students should go through pre-defined phases according to the subject summary to obtain approval.



Graphic two. Gamification elements most used

The research also obtained information about which tools, developed for own experiment or already existent, were used to gamify learning. From the total studies evaluated, 13 used gamified tools, 4 of them being free for use and 1 available through purchase. The other 8 studies didn’t make their tools available for the public (reference to research question eleven). Table 8 presents the tools available for the public for free or by acquiring a license.

Table 8. Open tools used by some studies

Study	Tools	Property
Barata et al., 2013	Moodle	Free
Sepehr et al., 2013	ERPSim (Enterprise Resource Planning Simulation Game)	Paid
Erenli, 2012	“Zombies Run!”, StoryTec e “The text of the riddle states” e Innov8	Free
Leffa, 2014	ELO (Online Language Teaching)	Free
Luma et al., 2014	ClassDojo e ClassBadges	Free

In reference to research question five, the positive and negative aspects of each experience were extracted, but for limitation reasons only some will be addressed in Table 9, the complete results are available in the report by Rousy and others (2015).

5. General Results

The results of the studies were analyzed and some observations emerged. Primarily, it’s important to know that gamifying education is not a trivial task, for it’s necessary to create specific rules to apply gamification in a system focused on the learning [Falcão et. al. 2014]. It is necessary to identify the context in which gamification intends to be used, the possible actions of the students, the gamification elements to be used and how the activities relate with the elements. The application of

gamification without studying its design and implementation may bring more damage than benefits, for the simple addition of points, badges and leaderboards to the didactic process may not be sufficient [Laskowski, 2015]. Another observation, raised by Akpolat et al (2014), says that if badges and ranks are too easy or too difficult to obtain, is not transparent and there is no immediate feedback for the user's actions.

Table 9. Sample of the positive and negative aspects

Positive Aspects	Negative Aspects
Competition improves learning, motivation and involvement	Competition has the risk of decreasing motivation and fun, causing negative feelings by losing the competition, also interfering in the groups' dynamic.
Students perceive the gamified system as very pleasant, encouraging and challenging	Students without reputation or with low reputation for not participating as actively as others may feel demotivated to answer or make questions for fear of not being up to those with greater reputation.
Competition also has the potential to make up for the lack of skill in certain activities	Not every student is motivated the same way by gamification, once motivations may differ from student to student.
Gamification facilitates discussion among students and promotes compensation to answer questions from colleagues.	Students with just the right amount of points to pass the subject were less motivated.
Anonymity or half-anonymity allowed students to express themselves more freely and comfortably.	Fear to lose focus of the activity if the participants exaggerate in the gamification, leading them to care more about winning than learning

Some studies highlighted yet the importance of trying to understand different type of students, for what motivates some does not work for others [Hakulinen et al., 2014; Herbert et al., 2014]. For example, in the study of Akpolat et al. (2014), gamification was very well received, but some students did not identify themselves with this learning approach and did not prefer it, although their learning performance was not affected. In search to comprehend what motivates different type of students and allow the gamification design to reach everyone, some studies researched deeper through questionnaires, using the theory of Marczewski (2013) based on Bartle's types of player. Another pre-study to the conception of gamification in education is the different types of engagement: behavioral, affective and cognitive; for it is proven to be positively correlated with the student's success, including satisfaction, persistence and achievements [Ibanez et. al., 2014]. Engagement is also said to be the result of the Flow state, reached though game dynamics and mechanics. Flow is, according to Csikszentmihalyi (1991), resultant of the level between challenge and skill in a task, used to measure how a person is immersed in an activity.

Complementary to the results shown so far, all studies had positive outcomes regarding the use of gamification in education, accomplishing all the objectives proposed, and even though some students didn't react excitedly (minority), their performance wasn't affected for the worst either. The general reaction, however, was of excitement and many of the students agreed that this technique should be implemented in other courses.

Gamification is an opportunity for education, to both students and teachers, besides being a good way of personal evaluation. If well applied it is a relevant activity in the student's life and will bring results greater than already exists through traditional teaching methodology. The research is substantial for its potential of application and addresses an activity in evidence and growth. There are still many doubts concerning if game elements can be more effective than linear presentations of educational content, however, gamification applied to education is particularly promising due to its potential to shape user behavior in desirable directions, to improve motivation and engagement.

6. Conclusions and Future Work

A lesson learned from the research is that applying gamification in the learning process is very promising, with all studies achieving success in their experiments, and some accredit that to the importance of the teacher's participation in the constant motivation of the students in class as much as in online activities; and also to the importance of group dynamics and communication, that must be observed and kept to assure the final result is achieved.

Another lesson brought to attention by some studies is that designing a gamified subject is not trivial, once the simple addition of points, badges and leaderboards to the didactic process may not be enough, which proves that gamification can be well received by some and not by others. It is necessary to consider some factors that will change according to each experience, adding details and observations that need to be reflected and properly adjusted, allowing user engagement and achievement growth. As an example of this are the consequences of the use of "Competition" that may come to have an adverse effect on motivation, since not all students are motivated in the same way. It is also necessary to work the group with the individual particularities of each one to know how to motivate this group to reach a result of success. Last, it is needed to enlarge the experimentation of the proposed methods for further validation, improvement and theme legitimacy.

As observed, gamification has been studied in several countries from all around the world, in the most varied areas, Information of Technology being the one that most used gamification in its curriculum subjects, showing that professionals with more familiarity with technology have sought to enrich the content approached in class. The motives to gamify work closely with the perception of information abundance and dynamics of the educational process. There are solutions to find or alternatives that takes advantage of technology, allowing students to interact more. The dynamic of education comes to transform, allowing higher learning and entertainment through the tools this new technique has to offer.

Gamification, as proven by many studies, makes the learning experience more pleasant and more effective. With so many benefits favorable to education, we're driven to question ourselves for what reasons skills already existent in students are not addressed and transformed when teaching more elaborate content.

As future work we intend to study in more detail some works such as Barata et al. (2013) and Luma et al. (2014) to perform a comparative study in the area.

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