



Gamification and Learning: A Comparative Study of Design Frameworks

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Abstract. This study aims to discuss design frameworks for gamification in education and learning, in order to compare project steps and find convergences and divergences in design processes. The research was based on literature review and collected data was compared. Therefore, the study presents gamification design frameworks selected from the literature review and the results showed two sorts of frameworks: models for structural and content gamification. It was found that there are more frameworks to design structural gamification than models to design content gamification. In addition, the frameworks are divided into pre-production, production and post-production phases. The comparison of the frameworks evinced that the most notable convergence between the models is the pre-production phase, which comprises the steps of comprehension and design of the gamified system, which, in general, are more detailed. Lastly, the main divergences were found in the production and evaluation steps, with the absence or indication of how the gamified system is produced or implement and how gamification outcomes are measured.

Keywords: Gamification · Education · Framework comparison

1 Introduction

For the purpose of this study, Gamification is understood as an approach used to archive a goal (for example, stimulate and motivate the execution of a task), through the use of game design elements. The introduction and growing expansion of gamification in education and learning contexts promote critical reflection on the development of projects which change the student learning experience.

The relevance of this research is the presentation of a comparative study of the gamification design frameworks for education and learning, with the objective of pointing out similarities and contrasts as a contribution to elucidate different methods and amplify technical and practical knowledge for educational use.

The literature review aimed at data collecting about gamification in education and learning processes with bibliographical material which presents conceptual, structural and procedural definitions, in order to find information about the characteristics of the design process phases.

The data collection occurred during March and September of 2017, in the international databases [1] and [2]. The search terms were: “gamification”; “education”; “learning”; “framework”; “model”; “design”; “designer”.

The criteria for selection were to find studies addressing at least two of the following topics: (a) definition of gamification; (b) elements of gamification in educational and learning contexts; (c) frameworks for designing gamification for education and learning. Thirteen studies have been selected in this research, divided by topic (six studies about gamification in education and learning; and seven regarding gamification frameworks) (Table 1).

Table 1. Studies selected in the literature review about gamification in education and learning.

Study topic	Selected studies	
Gamification in education and learning	Deterding et al. [3]; Zichermann and Cunningham [5]; Kapp [7]; Nah et al. [10]; Kapp et al. [8]; Landers [4]	6
Gamification frameworks for education and learning	Simões et al. [11]; Landers [4]; Kim and Lee [9]; Klock et al. [13]; Urha et al. [14]; Andrade et al. [15]	7

The study contains the following sections: (1) **Gamification in Education and Learning**, which presents concepts and principles of gamified systems to promote learning; (2) **Gamification Frameworks for Education and Learning**, to dissert about the models for designing, developing and applying gamification to educational and learning contexts; (3) **Results**, with the comparative study and the synthesis of the phases of the frameworks presented; and (4) **Conclusion**, for final considerations.

2 Gamification in Education and Learning

Gamification is explained by [3] as a term which has its origins in the digital media industry during the year 2008 and was widely adopted since 2010, coexisting with terms such as “productivity games”, “funware”, “behavioral games”, “playful interactions”, “playful design”, “pervasive games”, “ludification”. To the authors, the term “gamification” demarks a group of phenomena not previously identified, considering the complexity of gamefulness, gameful interaction and gameful design, which differs from the concepts of playfulness, playful interaction, or design for playfulness.

The definition proposed by the authors describes gamification as “the use of game design elements in non-game contexts” [3]. From this point of view, gamification is related to gaming rather than to playing and refers to the use, to design and to elements characteristic for games, in non-game contexts, regardless of specific usage intentions.

Gamification is defined by [4] as the use of game elements, including action language, assessment, challenge, control, environment, game fiction, human interaction, immersion, and rules/goals, in order to facilitate learning process and its outcomes. The author also proposes the differentiation between gamification and serious games, by the means each engender learning. While games assume the role of instructor and provide content directly to the students, gamification, in a general way, does not seek to

influence learning directly. Its goal is to enhance pre-existing instruction by changing learner's behavior and attitude.

According to the authors, although games can affect motivation, it is not its goal to do it without also providing instructional content. Thereby, "although one might claim that they learned from a game, it would generally not be valid to say that they learned from gamification" [4]. Thus, even though serious games and gamification share game design elements, the process by which those elements affect learning differ.

Gamification can mean different things, as alleged by [5]: make games to promote products and services; create virtual worlds to change behaviors; or provide a way to train people in complexes systems – gamification unites all those senses and possibilities of game in non-gaming contexts.

The authors unite the concepts as serious games, advergimes¹ and games for change² and define gamification "the process of game-thinking and game mechanics to engage users and solve problems", applicable "to any problem that can be resolved through influencing human motivation and behavior".

Gamification definitions that are based on the mere addition of game elements in activities are criticized by [7], since those approaches are usually superficial, which do not generate learning, engagement or productive improvements.

The author defines gamification as "a careful and considered application of game thinking to solving problems and encouraging learning using all the elements of games that are appropriate". By this definition, the objective of gamification is to add game based elements to contents that usually are presented as a lecture or an online-course in order to create a gamified learning opportunity either in the form of an educational game or in the form of game-elements on top of normal tasks.

The definition presented by the author does not exclude serious games from gamification. The goal of both serious games and gamification is the same – to solve problems, engage people, and promote learning by using game thinking and mechanics. Thus, designing a game based on instructional content is the gamification of the content and the same thought processes, techniques, and approach are needed. The use of serious games are considered a form of gamification, as serious games are a specific sub-set of the meta-concept of gamification and includes the idea of adding game elements, mechanics and thinking to instructional contents [7].

According to [8], gamification can be used to motivate interaction and learning; encourage the execution of challenging tasks; achieve goals; create an opportunity for critical reflection; and change the behavior in a positive way. The authors explain that there are two types of gamification: structural gamification and content gamification.

Structural gamification refers to the application of game design elements to motivate the learner through an instructional content without changing it. It can be made by using clear goals, rewards for achievements, progression system and status, challenge and feedback.

¹ Advergimes or advertainment are games designed for advertisement, with the specific propose of publicize a product or a service to the costumers [6].

² Games for Change is an initiative published on the internet, popularly known by the acronym G4C, <http://www.gamesforchange.org>, last accessed 2018/10/11.

Content gamification is the application of elements, mechanics and game thinking to make the content more game-like. However, this does not necessarily imply designing a full game. Content gamification provides game context or activities to the instructional content. Elements that can be used to that goal are story and narrative; challenge, curiosity and exploration; characters and avatars; interactivity, feedback and freedom to fail [8].

3 Gamification Frameworks for Education and Learning

Next, the selected frameworks for designing gamification for education and learning will be presented with its detailed phases and purposes.

According to [8], there are two types of motivation to be considered while designing a gamified system: extrinsic and intrinsic. The extrinsic motivation is used to increase the satisfaction and dedicated time to complete a task; strengthen the perception of freedom of action; keep focused attention for short periods of time; or to motivate the student when initially they view the activity as low value.

On the other hand, intrinsic motivation is based on auto determination and autonomy, competency and relatedness, which can be used to give the student the sense of choice and control; increase his confidence when challenged to accomplish a goal; provide a way to master a skill or content; reward gradual and final learning improvements; help the student to feel connected to others by using social interactions, such as leaderboards or challenging other students.

Table 2. Elements of mechanics, dynamics and aesthetics (Based on [9]).

Mechanics	Points, levels, leader board, goal, badges, quests, onboarding, virtual items, feedback
Dynamics	Dynamic system, pacing, reward scheduling, time-based pattern & system, progressive unlock, appointments
Aesthetics	Love, beauty, delight, honor, thrill, surprise, envy, connection, comedy

One of the recurring approaches in literature is MDA (mechanics, dynamics, and aesthetics) [5]. The authors explain that this approach is used to create an interrelation between the elements of game design elements in a non-gaming context. Examples of game design mechanics, dynamics and aesthetics are mentioned by [9] (Table 2).

The Dynamical Model for Gamification of Learning purposed by [9] is a framework for structural and content gamification, based on four game characteristics: challenge, fantasy, control and curiosity, to make the educational and learning process more dynamical. Each characteristic is related to a game design element of mechanics, dynamics or aesthetics (Fig. 1).

The authors purpose relations between the characteristics: **control** is the efficacy and core of the gamification, in which **curiosity** (with elements of dynamics and aesthetics) needs to be greater than the **challenge** (that has elements of mechanics and dynamics). However, with time, motivation tends to decrease and the proportion

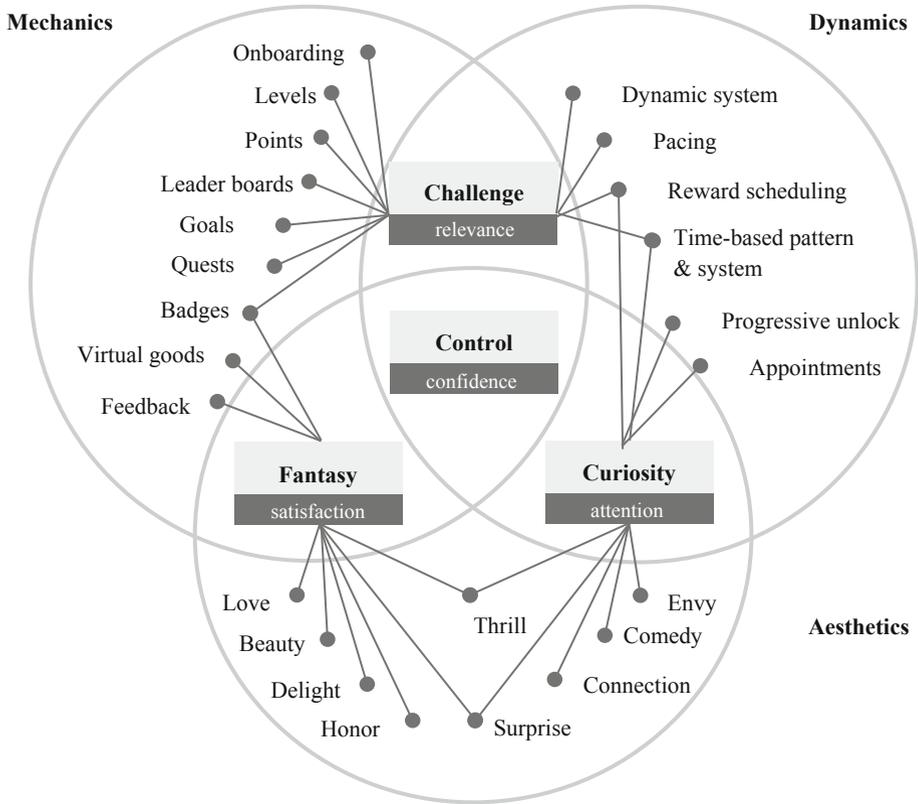


Fig. 1. Dynamical model for gamification of learning (Adapted from [9]).

between **challenge** and **fantasy** (which has elements of aesthetics and mechanics) must be maintained in order to guarantee the efficacy of the gamified system.

Gamification for education is discussed by [10] based on three principles:

1. **Gamification:** Driven by goal orientation, achievement, reinforcement, competition and fun orientation. These principles are part of the gamification process and help the student understand his tasks, keep focus, be motivated by his accomplishments and achievements.
2. **System design elements:** Elements such as leaderboards, levels, points, onboarding, challenges, badges, feedback, social engagement loops, social dynamics, rules, visual, avatars, customization, narrative, and role-play are important and the overall experience of a game depends on how well the system design can enhance user experience.
3. **Engagement:** Refer to outcomes of gamification, with cognitive absorption, in a state of deep attention and involvement. It includes recency, frequency, duration, virality, ratings, curiosity, control, temporal dissociation, immersion, and enjoyment (Fig. 2).

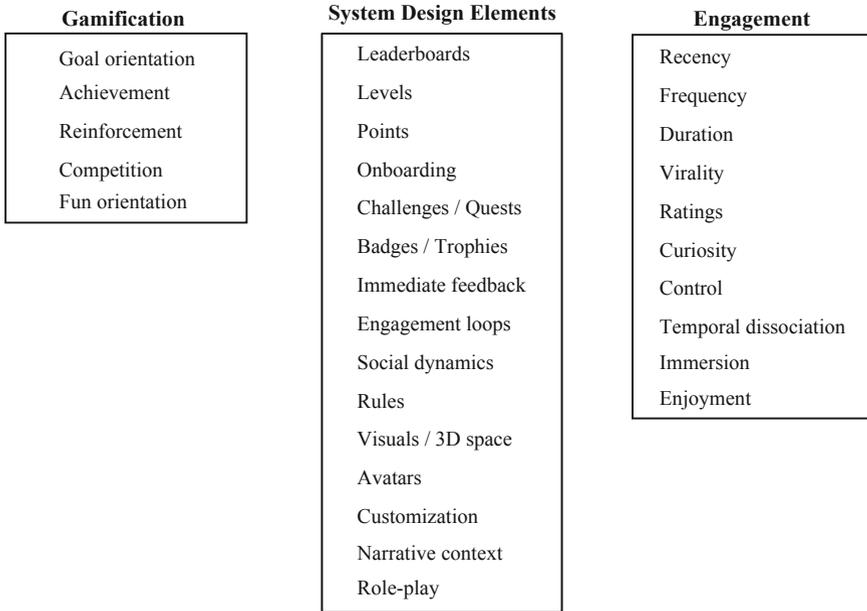


Fig. 2. Synthesis of gamification for education (Adapted from [10]).

The Reference Model for Applying Gamification in Education suggested by [11] present phases of characterization of the context; identification of instructional objectives; selection of game design elements; data analysis; and insertion of content into activities.

1. **Characterization of non-ludic context:** involves the identification of the characteristics of the context, the activities; the definition of desired behaviors and user profile.
2. **Identification of the objectives:** is to decide the instructional objectives according to the desired behaviors.
3. **Game design elements selection:** is to define components which provide feedback and rewards, social interaction, and game experience.
4. **Data analysis:** collect and analysis data in conform to the objectives; evaluate and share outcomes.
5. **Insertion of contents in the activities:** determination and insertion of contents according to the data analysis, outcomes and context (Fig. 3).

The authors explain game design elements for the gamified system: **feedback**, which provides answer to the actions materialized with **rewards**. **Social interaction** occurs by the collaboration and sharing, while **fun** must be present to engage the user. The component **game experience** has the function of keeping the user engaged along the course, whilst the economy establish rules for virtual goods trade and progressive rewards define the periodicity and acquisition criteria (Table 3).

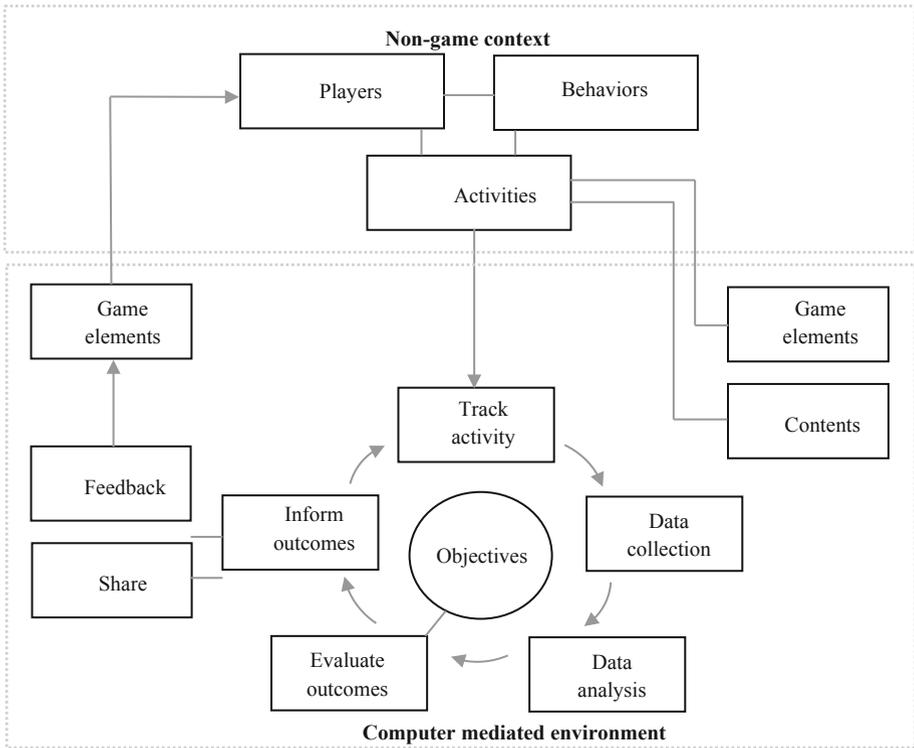


Fig. 3. Gamification for education cycle (Taken from [11], translated by the authors).

Table 3. Game design elements (Taken from [11], translated by the authors).

Fundamental components		Game elements
Flow and fun	Feedback and rewards	Points, leaderboards, progress bars, badges, trophies
	Social interaction (friends)	Share badges, invite friends, give/demand/swap virtual goods
	Game experience (gameplay)	Levels, intermediate objectives, clear goals, repeat after fail is fun (fun failure), rules, virtual economy, and progressive rewards

The Framework for Social Gamification purposed by [12] aims to create appropriate challenges to the student according to his level; establish simple goals and offer different ways to achieve the objectives; choose proper game mechanics to the activities; consider fail as part of the process and help the student to deal with it; allow the student to assume other identities and roles; allow the student to identify and keep track of his progress; and use competition to stimulate positive behaviors. The authors interrelated game mechanics and dynamics to achieve needed attitudes (Table 4).

Table 4. Relations between game mechanics and dynamics (Based on [12]).

Mechanics	Dynamics
Points	Rewards
Levels	Status
Badges	Achievement
Virtual goods	Self-expression
Leaderboards	Competition
Virtual Goods	Altruism

The Framework for Social Gamification involves the definition of needed behaviors for the student. After this phase, the game design elements are defined and implemented through gamification tools, directly applied to the social learning environment and to the instructional content. By means of gamification, expected behaviors improve learning outcomes (Fig. 4).

Learning occurs by two processes in gamification, in structural gamification, according to [4]: one more direct, the mediating process, and one less direct, the moderating process. Both processes presume that these changes improve learning, presupposing the instructional material is well designed and the content interesting.

The influence of characteristics of games or the instructional content in behavior and learning outcomes is a mediating process. This process defines a desired behavior to improve learning outcomes, by using game elements, such as narrative, to increase the amount of time students spend with the instructional material. On the other hand, the influence of the behavior and the attitude on the instructional content and learning outcomes is a moderating process. This occurs when, by using a game element, the student motivation increases (Fig. 5).

The Conceptual Model for Gamification in Virtual Learning Environments purposed by [13] consists in defining four dimensions to structural gamification: “Why”, “Who”, “What” and “How”, in order to answer questions to apply gamification.

- **Why?:** refers to wanted behaviors, which can be related to theoretical activities (accessing materials); practical (exercise and tasks; increase the performance in tasks); social (forum activity). And related to the system (increasing the amount of time using the system and frequency of access).
- **Who?:** the users of the system, mainly teachers and students.
- **What?:** define which system components will be gamified.
- **How?:** determine which game elements will be used to increase motivation and achieve wanted behaviors in who will interact with the gamified system (Fig. 6).

To understand user profiles and adopt compatible strategies, the authors use the taxonomy of Richard Bartle, which divides players into four categories: achievers (players who want to achieve goals in the game); socializers (those who like to interact with other players); explorers (players who enjoy exploration and discovery through the game world); and killers (players who are driven by competition and winning). The authors use this taxonomy as a strategy of the phase “Who?” to identify users profile with the use of surveys and questionnaires. There may be mixes profiles, which can benefit of the following elements:

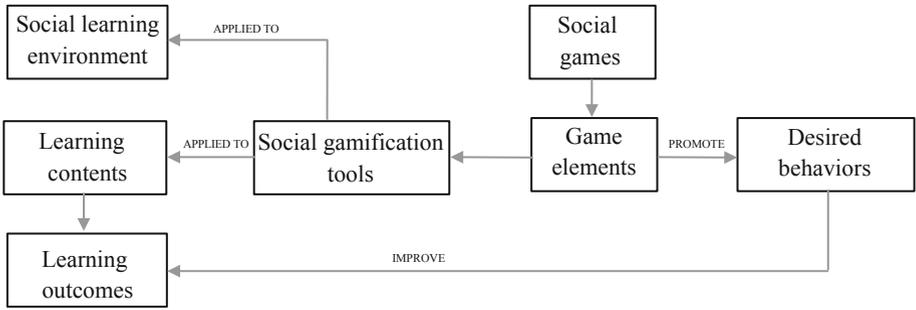


Fig. 4. Framework for social gamification (Taken from [12]).

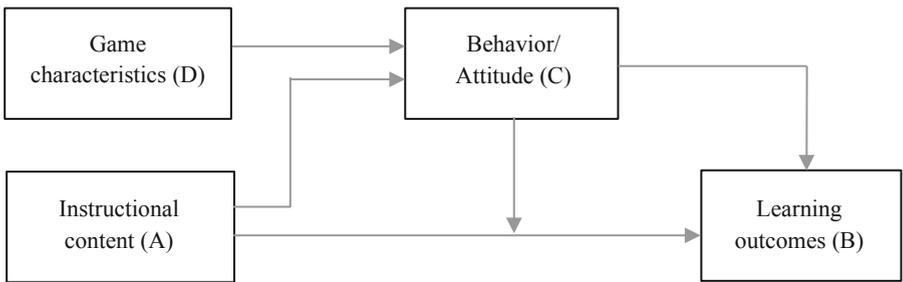


Fig. 5. Theory of gamified learning. The sequences (D, C, B) and (A, C, B) are mediating processes. The influence of C in (A, B) is a moderating process. Directional arrows indicate theorized path of causality (Taken from [4]).

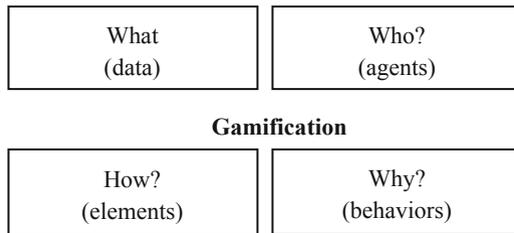


Fig. 6. Dimensions of the conceptual model for gamification in virtual learning environments (Taken from [13], translated by the authors).

- **Achievers:** points, levels and badges.
- **Socializers:** communication tools such as forums and chat.
- **Explorers:** hidden challenges.
- **Killers:** ranking, leaderboards.

The Model for Introduction of Gamification into Learning purposed by [14] presents an approach based on the phases of analysis, planning, development, implementation and evaluation to apply structural gamification.

1. **Analysis:** involves data collecting about pedagogical and technological issues, design, administration, people, learning material and gamification.
2. **Planning:** phase to define what, when and how will be developed.
3. **Development:** step in which the project is implemented in the virtual environment and the solution is tested.
4. **Implementation:** phase in which the solution is presented to the users and is monitored for adaptation with user feedback.
5. **Evaluation:** is the verification of the satisfaction and motivation of the user with the system to assess if the objectives of the project were fulfilled, verify the efficiency of the system, and to check the user learning experience.

The process flows in a linear way and considers elements of user experience: project management, user-centered design, usability evaluation, information architecture, interface design, interaction design, visual design, accessibility and web analytics. In addition, the authors list the following elements of gamification (game mechanics and dynamics) that can be incorporated to the learning process (Table 5).

The Framework for Intelligent Gamification presented by [15] aims to guide the development of structural gamification based on the following steps: information gathering, operation, assessment and adaptation.

1. **Information gathering:** data collecting about player profile, his psychological and behavioral attributes, gamification, psychological and interaction patterns.
2. **Operation:** adaptation of the interface to the game design elements provided by the student profile.
3. **Assessment and adaptation:** The system verifies the interactions of the students and the chosen game elements to see if any change in the process is needed (Fig. 7).

According to the authors, there are three layers in the Framework for Intelligent Gamification: the layer of gamification, the layer of the tutor and the data layer.

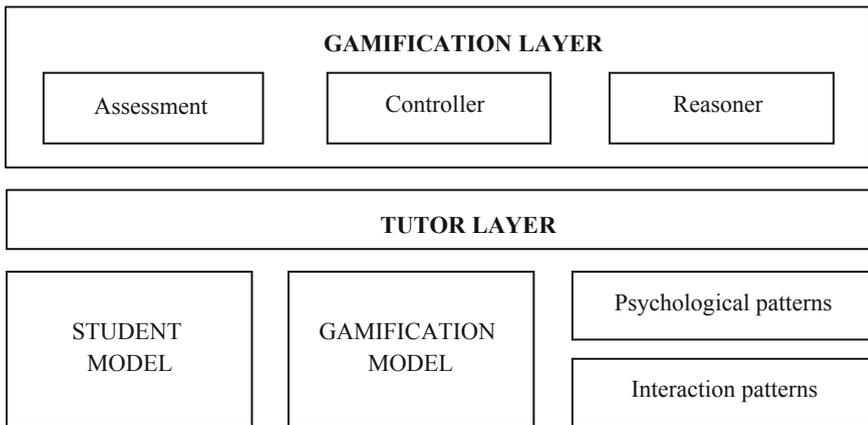
The data layer has the **student model** with his motivational, behavioral patterns, his attitudes, habits, interaction and information about his profile; the **gamification model**, with game mechanics and possible events to be added to the system, **interaction pattern** expected, to keep track of the actions in quantity and sequence; and the **psychological pattern** which provides information of the personality of the student during tasks.

The gamification layer refers to the interaction with the student to accomplish the motivational needs by the use of the operational modules for **assessment**, which analyses the actions of the student and make adaptations to the system; the **controller** component that establishes data crossing in order to customize the gamification; and the **reasoner**, which evaluates system data and the interactions of the students to compare to the information pattern in user profile, interaction and psychological patterns.

Lastly, the tutor layer provides decisions to provide better content and gamification customization according to the performance of the students.

Table 5. Gamification elements in learning (Adapted from [14]).

Elements of gamification in learning	Game mechanics	Game dynamics
Rule-based system	Points	Rewards
Clear goals	Badges	Status
Small tasks	Levels	Achievements
Immediate Feedback	Challenges	Competition
Positive reinforcement	Virtual goods	Altruism
Rewards for accomplishing tasks	Leaderboards	
Measurable progressive challenge	Gifts	
Story behind		
Voluntary participation		

**Fig. 7.** Framework for intelligent gamification (Adapted from [15]).

4 Results

Based on the literature review, it was observed that frameworks, in a general way, are focused on structural gamification. Only one framework of the selected literature [9] meets the requirements to design both structural and content gamification.

During the framework comparison, it was noted the following phases and steps:

Pre-production:

1. **Comprehension:** step to analyze the context, user profile, technology and to identify the design needs, noted by the terms: context characterization; identify objectives; “what?, who?, why? how?”; data analysis; information gathering.
2. **Design:** includes defining the concept and the design of the gamification, with the determination of the behaviors to be achieved through the use of game design elements, reported as: insert content; select elements of games; define behavior, game elements and learning content; define behaviors, characteristics of games,

Table 6. Comparison between the nomenclature and phases of frameworks for designing gamification for education and learning.

	Pre-production		Production	Post-production	
	Comprehension	Design	Development	Application	Evaluation
Dynamical model for gamification of learning [9]	-	Define elements of challenge, fantasy and curiosity	-	-	-
Reference Model for Applying Gamification in Education [11]	Context characterization, identify objectives, data analysis	Insert content, select elements of games	-	Track activity	Evaluate outcomes
Model for social Gamification [12]	-	Define behavior, game elements and learning content	Implementation	Implementation	-
Theory of gamified learning [4]	-	Define behaviors, characteristics of games, instructional content	-	-	-
Conceptual Model for Gamification in Virtual Learning Environments [13]	What?, who? how? why?	What? how?	-	-	-
Model for introduction of gamification into learning [14]	Analysis	Planning	Development	Implementation	Evaluation
Framework for Intelligent Gamification [15]	Information gathering	Information gathering, operation	Operation	Operation	Assessment and adaptation

instructional content; “what? how?”; define elements of challenge, fantasy and curiosity; planning; information gathering; operation.

Production:

3. Development: involve the production of the gamified system in which the game design elements are implemented or the application of those elements in an existing learning system, observed by the use of the terms: implementation; development; operation.
4. Application: step in which the gamified system is used by the students, verified by the terms: track activity; implementation; operation.

Post-production:

5. Evaluation: phase to verify the learning outcomes from the gamification use, noted by the use of the terms: evaluate outcomes; assessment and adaptation.

It was noted that some frameworks to design gamification are focused in determining the behaviors and goals to achieve by motivating students and defining game design elements for engagement. Those definitions occur in the pre-production, during the design phase.

In addition, some frameworks do not cover phases of production and post-production, lacking some steps of production, application and evaluation of the gamified solution. Hence, the identification that evaluation occurring only at the end of the process is problematic for the adaptation for learning. Those findings may indicate that the participation of the designer, teacher and student in the design process is limited.

The following table presents the comparison of the phases and its terminologies of the selected frameworks extracted from the literature review (Table 6).

5 Conclusion

The literature review indicates that there is no agreement by the consulted authors about the definition and reach of gamification in education – if the use of game elements which make the instructional content more game-like is or not gamification. This discussion can be taken to the epistemological field to confer if the magical circle³ is considered to be an essential game element or not⁴. It is relevant to ponder that in the hypothesis of the gamification space does not look like a game, it is still a closed place, apart from the ordinary world. Thus, one of the most cited gamification characteristics – the use of game elements, is important in motivating actions and promoting behaviors. Based on this, it is possible to drive students to immersion in the gamification space during the process. So, it is possible to allege that the circle – as a closed space, isolated, in which some rule-based activities are practiced – still exists, either as a virtual learning environment or an application.

Nevertheless, studies have been published about both biases (structural and content gamification). The literature review of the frameworks showed that the majority of the models are for structural gamification design – although there are also models to design both structural and content gamification such as [9], and some authors report gamification design processes as game-based learning design processes [8] as well.

The identification of the phases of the frameworks for designing gamification for education and learning and its comparison was essential to comprehend the process. The gamification process concentrate efforts in the pre-production phase, especially during the design step. The most impacting lacunas were found in the production and post-production, with lack of application and evaluation procedures.

³ The magic circle, in the context of play, according to [16], is a temporary world within the ordinary world, isolated hedged round, within which special rules obtain. This concept was expanded to the digital media by [17].

⁴ Divergent points of view about this issue can be found in [18–22].

The literature review evinced that gamification for education and learning can be designed through many different approaches and methods. Lastly, the consulted authors agree that it is the designer's responsibility in collaboration with teachers and tutors to plan a model of gamification according to the learning context and user profile that may engage and help the student to reduce frustration of failure during the learning process by recognizing efforts through the use of elements available in the gamified system.

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