

Entry

Gamification in Education

Athanasios Christopoulos^{1,2,*}  and Stylianos Mystakidis^{3,4} 

¹ Department of Informatics and Telecommunications, University of Ioannina, 47100 Arta, Greece

² Turku Research Institute for Learning Analytics, University of Turku, 20014 Turku, Finland

³ School of Natural Sciences, University of Patras, 26504 Patras, Greece; smyst@upatras.gr

⁴ School of Humanities, Hellenic Open University, 26335 Patras, Greece

* Correspondence: athanasios.christopoulos@kic.uoi.gr

Definition: Gamification, or gameful design, refers to the strategic application of game design principles, mechanics, and elements into non-game environments. It is often facilitated using digital platforms, aiming to solve problems, increase engagement, and motivate individuals towards their goals. The technique fosters a gameful and interactive experience, enhancing perceived autonomy, competence, and relatedness among users. With roots in fields like education, business, marketing, and services, gamification is a versatile tool that serves to enrich user experience and create value in a multitude of settings. The widespread impact of gamification across various sectors has transformed traditional methods of engagement, notably in education.

Keywords: gamification; education; mixed reality; metaverse; serious games; engagement; motivation

1. Introduction

Play is a fundamental human practice that can spark curiosity and facilitate skills acquisition and behavioral change. Fundamental research in the field of affective neuroscience has revealed seven basic emotions that humans share with other mammals [1]. Several of these emotions are quite expected and part of everyday life and activity, such as fear, anger, and care. Two of these emotions are quite surprising and of special interest to education: exploration (seeking) and play [1], with each one of these being essential elements of games. Games can be defined as rule-based systems of meaningful choices towards desirable goals. Games such as sports and board games have been the staple of ancient human civilizations [2].

Gamification was first coined in 2008 by Shirky and Terrill [3]. Gamification stems grammatically from the verb gamify, which was presumably first used by Richard Bartle in his work on the first Multi-User Dungeon (MUD), one of the first computer-generated gameful and social virtual worlds [3]. Gamification (or gameful design) is one popular motivation enhancement method [4]. Other methods include playful design (or playification), toys, and serious games. Playful design is a quick and simple method to integrate elementary game attributes or aesthetics in a non-gaming educational context for attention and interest enhancement [5]. It relies upon simple qualitative elements, such as themes, narratives, characters, and metaphors [6]. Toys are self-contained objects that can be utilized for playful purposes. One toy-based method is Lego serious play [7]. Serious games are games with a purpose beyond entertainment. Serious games in education constitute complex systems with goals, rules, and game mechanics that merge gameplay with learning [8]. One example of serious game type is the serious escape room or educational escape game [8,9].

Importance and Impact

The integration of gamification techniques into various sectors of the economy and society has been a notable trend. A systematic review has revealed that the domain of



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education and training emerges as a primary area where gamification is both implemented and researched extensively [10].

Within the educational landscape, gamification’s potential for transformative impact extends beyond merely making learning ‘fun’. Research suggests that well-designed gamified environments can foster a range of cognitive and emotional benefits, such as enhanced problem-solving abilities, collaborative skills, and resilience in the face of challenges [11]. Further, gamification can be particularly potent in nurturing intrinsic motivation, thereby contributing to long-term engagement and learning gains [12,13].

As an instructional approach, it extends to various disciplines (science, technology, engineering, mathematics, arts), with each employing unique mechanics and reward systems tailored to the learning outcomes of the discipline [14]. Indicative examples include point-based grading systems [15]; leaderboards for academic achievements [16]; and even more intricate constructs, such as game-based learning platforms that simulate real-world scenarios [17]. Beyond K-12 education, gamification has also infiltrated higher education and professional training environments, where interactive online courses often employ game elements to enhance learner commitment [18,19].

Given the multidimensional benefits and versatile applicability of gamification in various educational contexts, the present work delves into the critical elements that contribute to the effective integration of gamification in education educational settings.

2. Design Frameworks

A systematic review of gamification design revealed 40 frameworks from various fields [20]. Out of these frameworks, six were selected and presented based on their popularity in the academic and professional gamification community. Moreover, the first three frameworks can be considered as the theoretical backbone of many gamification models and methods. Table 1 summarizes the features of these essential frameworks.

Table 1. Overview of gamification design frameworks.

Gamification Design Framework	Essential Structural Elements	Applicability
MDA	Game mechanics, dynamics, aesthetics	Gamification design method targeting specific user emotions
Fogg behavioral model	Motivation, ability, prompts (triggers)	Design of gamified loops of engagement towards behavioral change
ARCS	Attention, relevance, confidence, satisfaction	Conceptual model aiming at sustainable learner motivation and positive experience
Oktalysis	Epic meaning, accomplishment, empowerment, ownership, relatedness, scarcity, curiosity, avoidance	Human-focused gamification design around eight basic motivational drives toward user engagement optimization
RECIPE	Reflection, exposition (story), choice, information, play, engagement	Gamified, storified experience design towards meaningful, deep learning
6D	Objectives, target behaviors, player’s profile, activity loops, fun, deployment	Sequential, iterative gamification design model based on design thinking

In the context of games, the mechanics–dynamics–aesthetics (MDA) framework has been used to break down and analyze the structural elements [21]. Mechanics are player actions defined by system rules, e.g., points, levels, quests. Dynamics are system affordances

created by mechanics, e.g., antagonistic player vs. player competition. Aesthetics define the affective impact on users. The same framework can be used in reverse by designers to target specific aesthetics and emotional responses, such as challenge, curiosity, self-expression, or sensation.

The Fogg behavioral model posits that human behavior is influenced by three factors: motivation, ability, and prompts or triggers [22]. Motivation is one of the most important affective aspects of learning, because it influences the cognitive processes of learning. Motivation has been described as the engine of learning [23]. When people like and enjoy online learning experiences that are meaningful to them, they tend to engage, take initiatives, act, and set and achieve their relevant goals in it. The level of ability in any context determines which action each player can execute. The difficulty level of gameful actions should optimally increase progressively and correspond to players' individualized ability to trigger the sense of flow. Prompts or triggers are gamification mechanisms that can be used to set up loops of engagement.

The central place of motivation in education is also recognized by the attention–relevance–confidence–satisfaction (ARCS) model [24]. This model aims at enhancing and sustaining the level of students' motivation by first gaining their attention and establishing how learning is personally relevant and meaningful for them. Next, learning must be arranged so as to promote students' confidence to complete and ensure that their overall satisfaction remains high.

The Oktalysis gamification framework further analyses the motivational drives in eight player incentives, such as epic meaning, creativity, accomplishment, social influence, and unpredictability [25].

The element of intrinsic motivation versus extrinsic rewards in a gamification system is prevalent in the proposed 'RECIPE' model of meaningful gamification [26]. This model suggests that gamified experiences should be organized around the essential components of playful exploration, narrative exposition, freedom of choice, effective information as well as feedback systems, engagement with peers, and reflection towards deep and meaningful learning.

The 6D model [27] provides a series of sequential steps for the design of a gamified system using a backwards analysis. It starts with the definition of the overall objectives and the associated target behaviors of the users of the system. The next step involves understanding the player types, characteristics and expectations. All these elements inform the choice of strategies and tools for short- and long-term engagement and progression loops.

3. Application Techniques

To understand gamification, it is important to become familiar with the fundamental components that make games engaging and fun (Figure 1). These include game mechanics [28], learning mechanics [28,29], and game aesthetics [30]. Below, we provide an in-depth exploration of each of these components.

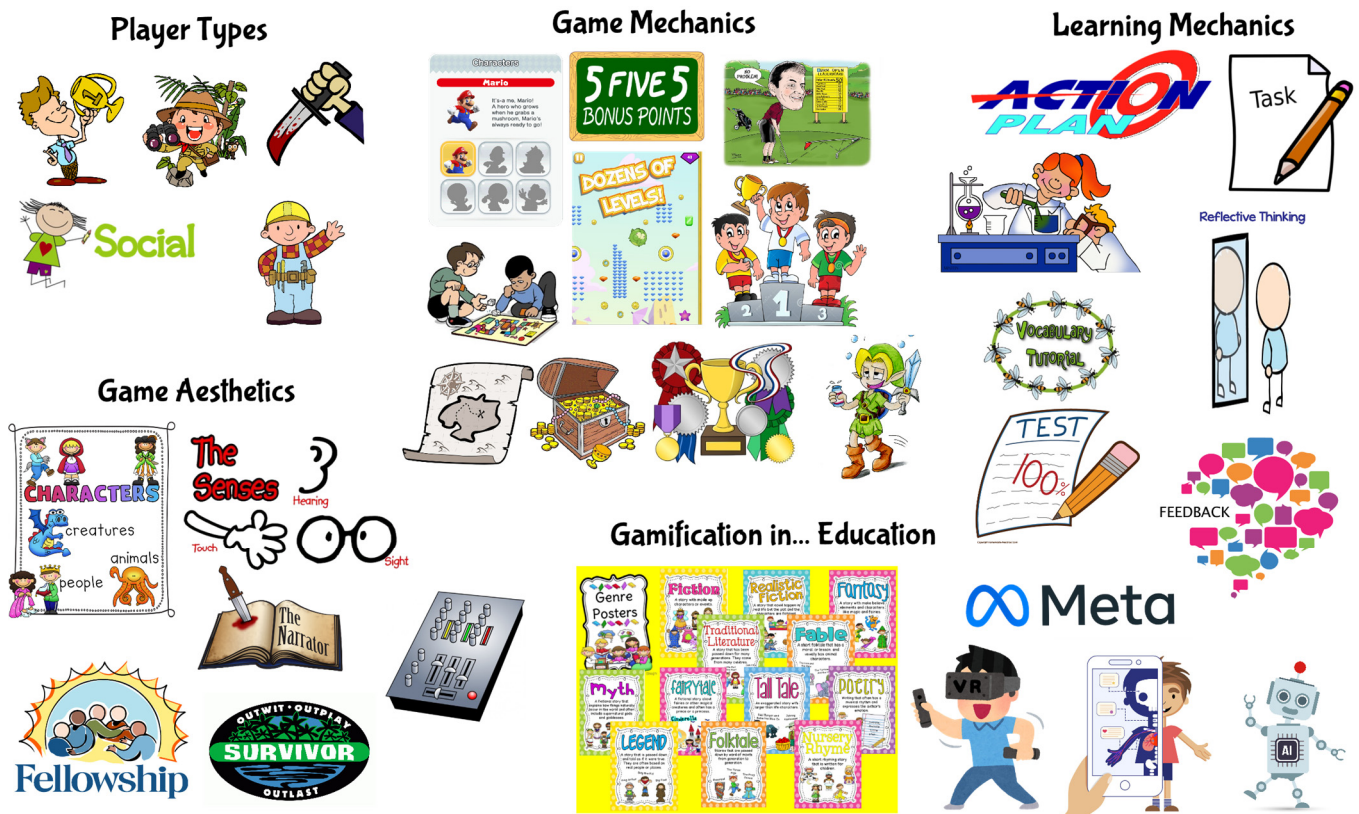


Figure 1. Overview of application techniques.

3.1. Classification of Player Types

Researchers have attempted to classify the various player types in accordance with the individuals’ personality traits, interests, and preferences. The most widely known taxonomy has been created by the authors of [31], who categorized players into four main types: achievers, explorers, socializers, and killers. However, ever since, a new player type has emerged describing those people who find strong motivation in creating interactive content, the so-called ‘creators’ or ‘builders’ [32]. Other practitioners differentiate between intrinsically and extrinsically motivated player types and propose additional types, such as the ‘philanthropist’ [33]. The main motivational drives and indicative gamification elements of each essential player type are illustrated in Table 2.

Table 2. Classification of player types.

Player Type	Core Motivational Drives	Gamification Elements
Achiever	Mastery, competency, accomplishment, excellence	Goals, rewards, quests, levels, badges
Explorer	Autonomy, discovery, curiosity	Choice, open worlds, branching scenarios, Easter eggs, bonus content
Socializer	Relatedness, community, communication	Teams, social network (contacts/friends)
Killer/disruptor	Winning, drama, status, attention, change	Competition, challenge, anonymity, voting
Builder/creator	Creativity, art, crafts	Modding, creativity tools, customization
Philanthropist	Purpose, meaning, altruism	Gifts, sharing, mentoring

In either case, the boundaries among these categories are not strictly limited, as individuals may express traits belonging to more than one role. Therefore, the descriptions provided below are indicative and should be utilized only as a guide to identify students' motivational traits prior to designing and implementing gamified educational activities.

3.1.1. Achiever

'Achievers' see personal-goal setting as the number-one priority [31]. Their main goal is to collect accomplishments, rewards (e.g., points, trophies, badges, items, levels) and anything else that makes one's progress (status) visible to others. Their main motivation stems from the intrinsic need to be competent. This also defines their primary objective, which includes the completion of challenging or demanding tasks, which often require great time and effort investment. In the educational context, achievers can be paralleled to the high-level students who strive for mastery and aim to excel in any given assignment.

3.1.2. Explorer

'Explorers' are free spirits; they find pleasure when discovering new places and features that underpin the flow of the game world [31]. In addition, they strive in mastering the game mechanics and dynamics that govern the functions of the game. Their ultimate goal is to understand the technicalities and uniquenesses of the game so as to craft theories and strategies that can help them and/or other players to take advantage. In the educational context, explorers are curious learners who enjoy the learning journey and are attracted by thematic or integrated approaches.

3.1.3. Socializer

'Socializers' are casual players who are foremostly interested in networking with others [31]. They value collaboration and teamwork and prioritize the development of meaningful, long-lasting relationships. In other words, instead of merely playing the game, they prefer to utilize the communicative facilities offered to create social and emotional connections. In addition, they are usually involved in community-related activities, which include administrative and managerial responsibilities. In the educational context, socializers are all about 'fun'. They feel attraction towards the social aspects of learning and perform best when engaged in collaborative learning activities.

3.1.4. Killer/Griever

Killers are highly competitive players who like to act on others [31]. Participating in competitions and tournaments (individual or team-based)—with the only intention to win—is the only motivational incentive. Like achievers, they are attracted by means and ends that lead to reputation and/or status increase and do anything within their abilities to beat their opponents. Grievers (also known as internet trolls) like to provoke and cause drama. To satisfy their need for attention, they disrupt others' experiences by either harassing or scamming them. In the educational context, killers are those students who are not taking anything at face value; they like being challenged and often ask the most questions. On the antipode, grievers are those students who demonstrate disruptive behavior with the aim to disturb the flow of the lesson.

3.1.5. Builder (New)

Builders can be (arguably) considered an addition to the aforementioned player types [34]. The term refers to those individuals who (solely or together) engage in recreational activities that involve (3D) content creation and/or animation, using both native and third-party tools. For builders, unlike professionals in the field, monetary compensation is not always the primary goal. As a buzzword, it became more prominent after the emergence of the so-called metaverse; a futuristic concept that describes and envisions a persistent, shared, interconnected, 3D virtual space. In the educational context, builders can be considered the students who are naturally inclined or interest in arts and crafts.

3.2. Game Mechanics

Game mechanics encompass sets of rules and feedback mechanisms designed to facilitate engaging gameplay (Figure 2). Often considered foundational elements, they can be adapted and integrated to introduce game-like features into non-gaming environments [28]. Different game mechanics are used to leverage players' motivational incentives and willingness to engage. For instance, the motivation driver for the collectors may be addressed with digital goods and the motivation for the achievement hunters may be addressed by leaderboards or badges. In a similar manner, failure mechanics are utilized to communicate the actions that players should and should not perform in a playful manner. In a holistic gamification design, a combination of different motivational drivers may be at play; yet, when learners are confronted with several game mechanics elements, it may be difficult to focus on the learning objectives. In greater detail, fifty-one (51) mechanics have been compiled in the periodic table of gamification elements [35]. Several of them can be associated with the main motivations of different player types. Some of the most popular gamification mechanics are presented below.

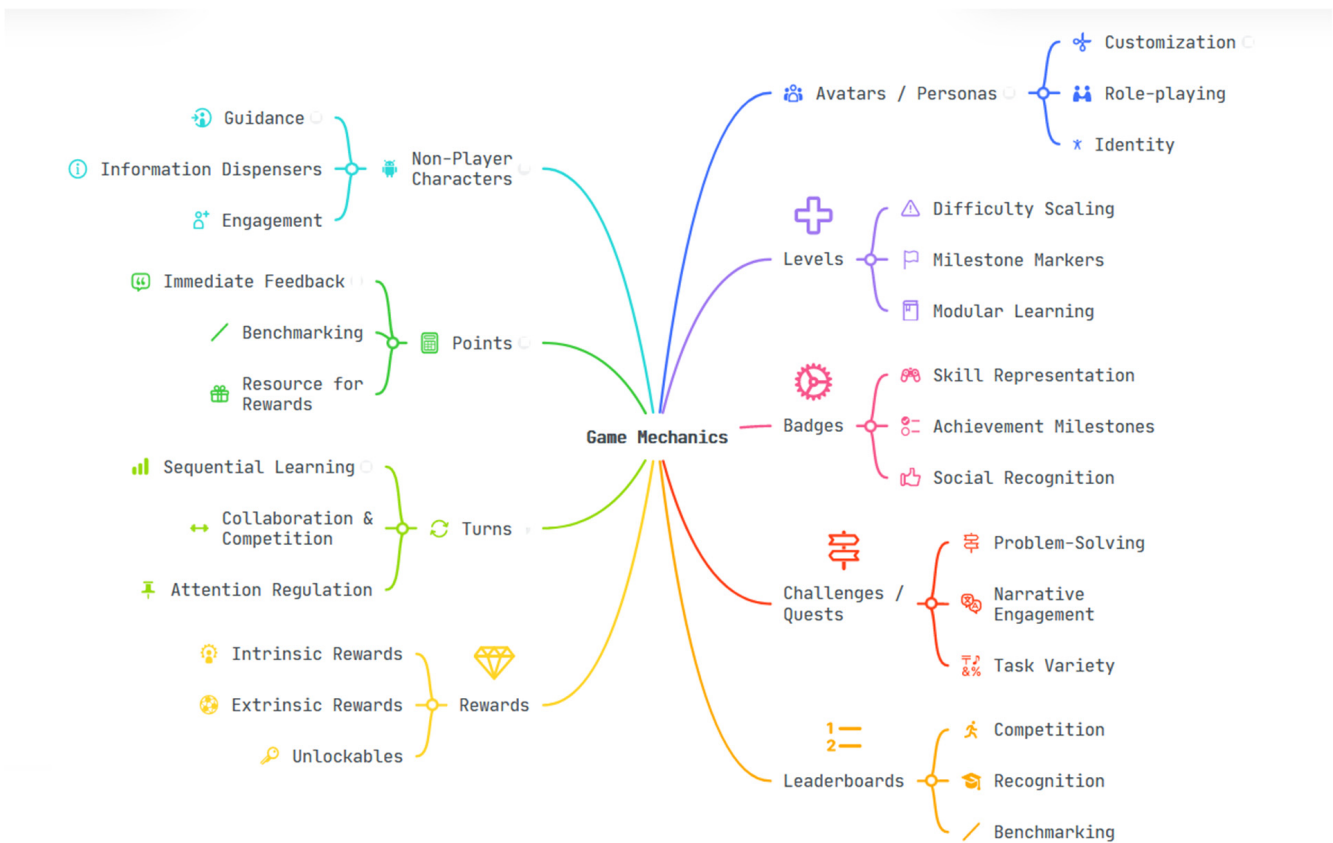


Figure 2. Overview of game mechanics.

3.2.1. Avatars/Personas

Avatars are digital representations of players within the game environment, often embodying the player's persona or character within the game. They enable players to interact with the game world, its inhabitants, and other players, effectively becoming the player's proxy in the digital realm. Avatars in gaming can vary, spanning from straightforward two-dimensional icons to intricate three-dimensional designs, influenced by the game's essence and design [35]. For many players, these avatars morph into a reflection of themselves, symbolizing their digital footprint, status, and triumphs within that virtual universe [36]. In view of education, avatars empower students by offering them a distinctive avenue to showcase their individualism, imagination, and personal tastes, be it through the altering of their looks, clothing, embellishments, or even inherent characteristics [37].

Such customization can amplify engagement levels, as students might find themselves emotionally tethered to their avatars, inducing feelings of empowerment and control in their educational journey [38]. Moreover, avatars offer a conducive space for practicing diverse social and communicative aptitudes within the protective confines of the digital realm, thereby enabling students to delve into varied roles and situations [39].

3.2.2. Points

Most games fundamentally rely on points as a primary game mechanism due to their efficiency in providing an easy-to-understand metric to gauge accomplishments or track advancement. Players typically earn points for fulfilling objectives, reaching milestones, or making noteworthy achievements within gameplay. Such points not only quantify progress but also play a crucial role in sustaining player involvement, as they provide tangible feedback in response to their in-game actions [40]. As an illustration, points can act as extrinsic incentives by challenging players to maintain their engagement with the gaming interface [41]. Point systems often vary according to the nature of the game and can be tailored to match the desired learning outcomes [42]. As such, the utility of points extends beyond simple numerical value; it represents progress, learning advancement, and achievement, thus enhancing the players' intrinsic motivation towards task completion [43].

3.2.3. Turns

In turn-based games, the progression is segmented into distinct, clearly delineated phases known as 'turns'. Turn-based games allow players to 'pause' the game world before making an action. However, not all game turns are alike. In some games, players may be allowed a period of analysis (time) before performing a game action, whereas in other occasions, turns may represent longer periods, such as years, months, weeks, or days. For instance, in wargames, the amount of time each turn represents is usually specified [44]. On the other hand, in sports games, a turn represents the 'one action play' that players can perform during their round, but the amount of time varies [32]. The most widely adopted approaches in the educational context are timed turns and time compression, both of which aim at adding time pressure to players to think and commit their actions [45].

3.2.4. Levels

Levels in a game are segmented portions or stages that players progress through as they engage with the game. They often represent an increase in difficulty or complexity as a means of presenting new challenges to the player. Attaining advanced levels gives players an affirmation of their proficiency in specific game techniques or educational targets, instilling a feeling of achievement and forward movement [46]. Within the educational sphere, levels can correlate to distinct learning segments or subjects. Progressing to an elevated level is indicative of fulfilling one learning goal and demonstrates preparedness to venture into more intricate subjects [47]. Moreover, these gradations lend a coherent framework to both the gaming and educational journey, ensuring that the entire experience is structured and digestible, mitigating feelings of being overwhelmed for both players and students [48].

3.2.5. Badges

Badges visually symbolize the accomplishments players attain after achieving certain targets or benchmarks within gameplay. These icons not only recognize and reward players for their capacity and dedication but also heighten their drive and involvement [49]. Beyond individual recognition, badges also present a communal aspect. They enable players to showcase their successes to peers, creating an atmosphere of both fellowship and completeness [50]. When applied to education, badges pinpoint mastery of particular educational goals or commend active involvement and contribution [51]. Mirroring the utility of levels, badges also offer a reflection of achievement, granting learners insights into their advancement and clarifying their position in the educational process [52]. Furthermore,

the process of striving for badges can encourage critical thinking and problem solving, as learners may need to figure out how to earn a particular badge, thereby enhancing the learning process.

3.2.6. Challenges/Quests

A quest refers to a specific task that a player-controlled character or group undertakes to earn a reward. In quest-based games, players engage in interrelated activities that usually involve movement across different action points [53]. The successful completion of a quest or set of quests (questline) leads to the attainment of a concrete objective or reward [54]. As an educational approach, Quest-Based Learning is structured as a sequence of briefing, action, and debriefing [55]. For this reason, the integration of this method is usually associated with the conduct of activities that involve problem solving, as the student players need to successfully address the posed challenges in order to progress and eventually complete the assigned task [56].

3.2.7. Rewards

Reward systems have a two-fold role: they act as incentives for players or as a means to alleviate potential disappointment. The reward mechanisms can be classified into the following categories: extrinsic motivation rewards (e.g., badges, points, and physical or virtual goods), which are responsible for attracting users' interest in the experience [57], and intrinsic motivation rewards (e.g., progress bars, notifications, status in leaderboards), which ensure the user's long-term engagement [58]. Similarly, the delivery system can take different forms, such as random rewards, fixed reward schedule, and time-dependent rewards [59]. Some of the most notable types of rewards include tokens, achievements, feedback messages, experience points, item granting, and content unlocking [60]. Players can use the obtained rewards to make game progress or as a means to demonstrate their knowledge advancement to instructors and peers [57].

3.2.8. Leaderboards

Leaderboards visually rank players based on their achievements. The structural elements of leaderboards can be divided into two levels: the macro-level (overall performance) and the micro-level (performance in specific tasks) [61]. Despite the differences observed regarding the provided information at each level, the key structural elements remain similar [62]. Considering the educational context, a typical leaderboard usually displays information related to students' identity (name or nickname), followed by their ranking, which is defined by either their learning progress (e.g., points, tasks completed) or performance (e.g., grade, budgets earned) [63]. As such, it allows students to gauge their performance relative to their peers.

3.2.9. Non-Player Characters

Non-Player Characters (NPCs) are integral elements in many video games. They act as intermediaries who offer quests or help to players toward the completion of the storyline. The key design elements and characteristics of NPCs are decided following a three-tier approach, which includes the global design level, which concerns the appearance of the NPC (i.e., human/non-human, animal, cartoon) and the motion capabilities (i.e., static/animated) [64]; the medium design level, which regards the technical aspects of the NPC (i.e., role, behavior, auditory output) [65]; and the detail design level, which relates to the visual presence of the NPC (i.e., gender, age, clothing) [66]. In educational settings, NPCs (also known as Pedagogical Agents) are integrated as a means to facilitate learning processes by providing learners additional instructional support and guidance, especially during the absence of the teacher or instructor [67].

3.3. Learning Mechanics

Learning mechanics refer to foundational patterns of behavior or interactive building blocks that a learner engages with (Figure 3). They can be formulated either as individual actions or as interconnected actions, with both constituting the core learning activities that are frequently repeated in a game [28]. Their key principles are grounded on established learning theories or models and constitute the medium that ‘translates’ the learning goals into gameplay elements [29]. Every educational game has learning mechanics that govern the rules and the interplay modalities used to motivate and engage players to complete the game and ultimately expand their knowledge and/or develop their skills.

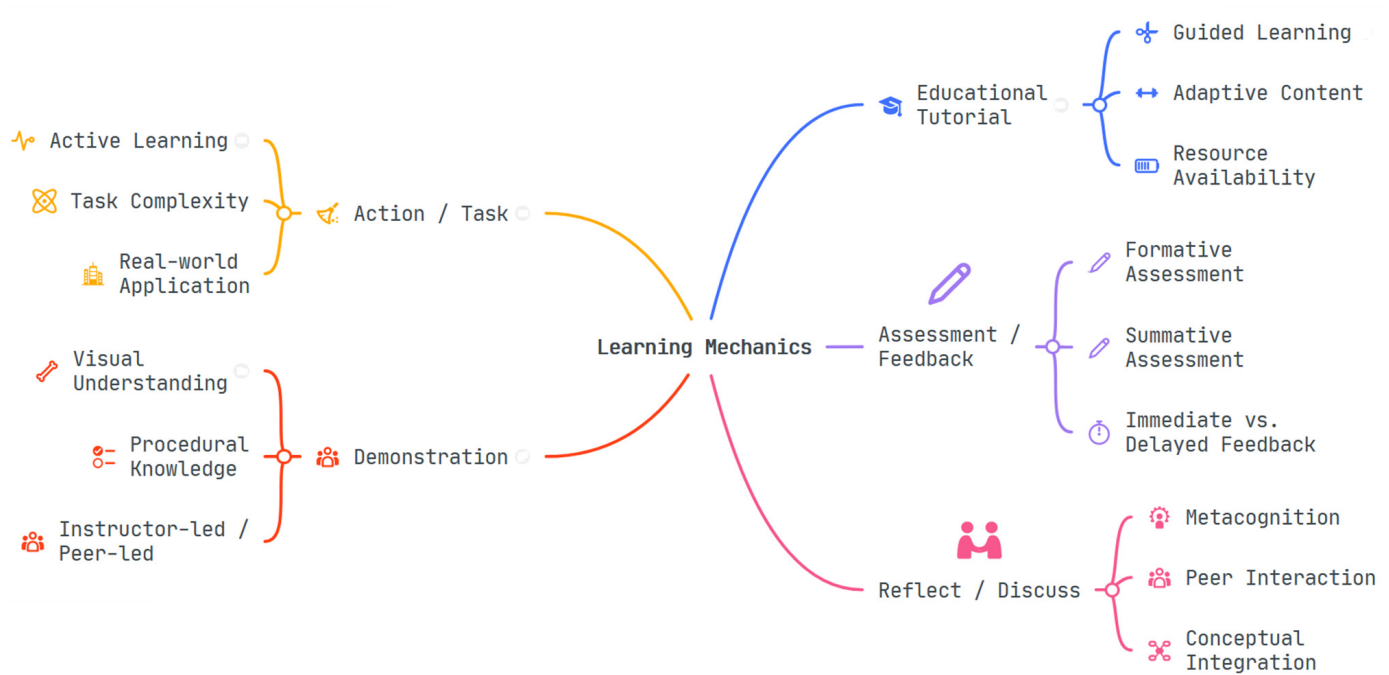


Figure 3. Overview of learning mechanics.

Below, we map and discuss the key elements of the most widely adopted learning mechanisms that can be utilized across different educational levels and contexts.

3.3.1. Action/Task

In digital learning scenarios, students are expected to perform a set of repetitive actions in order to complete the given tasks. Educational games framed under this category mainly rely on the principles of problem-based or task-based learning, whereas in cases where the students are required to work together to achieve a common goal, it could also be related to collaborative learning. Depending on the nature of the educational task, students can develop a wide range of cognitive (e.g., planning, critical thinking, problem solving) [68], technical (e.g., knowledge development with new techniques or practicing already known techniques) [69], or social (e.g., knowledge, information, or opinion exchange) skills [70]. Educational activities associated with this mechanic include role playing, paired/group discussions, exploration, observation, and other ‘hands-on’ activities.

3.3.2. Educational Tutorial

Educational tutorials are instructor-guided and/or self-paced activities that enable learners to acquire theoretical knowledge or consolidate their practical skills [71]. As a learning mechanic, it draws from the principles of the Constructivist/Constructionist models and occasionally involves collaboration among students (e.g., on course assignments) [72]. Depending on the nature of the educational subject, they can be discussion-based, where

the focus is on the deeper exploration of the course content through discussions and debates [73], or may involve hands-on activities, where the emphasis is on the development of practical skills [74]. In either case, the added value of this approach is also the opportunity offered to learners to participate in (follow-up) question-and-answer sessions. For the integration of this mechanic, the use of diverse multimedia resources is recommended (e.g., PowerPoint presentations, videos, NPCs).

3.3.3. Demonstration

Virtual learning environments empower educators to illustrate abstract topics and concepts that may be challenging or unfeasible to delve into within traditional classrooms [75]. Educational games framed under this category mainly rely on the principles of Behaviorism, when simulating scenarios that highlight the relationships between ‘cause and effect’ [76], or on the Experiential Learning approach, when the students are requested to observe and imitate the actions that the educator in charge performs [77]. In cases where the educational activities involve interplay among the students (e.g., competition, collaboration/cooperation), this approach can also be linked to Social Learning theory [78]. Educational activities associated with this mechanic include simulations, 3D modeling and programming, scenario-based virtual field trips, and guided explorations via storytelling.

3.3.4. Assessment/Feedback

Beyond the conduct of activities that facilitate learning, designers and practitioners can also integrate assessment-related tasks as a means to enable learners to acquire insights related to their learning progress and advancement. In serious games, learner assessment can be continuous (e.g., proceeding from level to level) with scaffolding difficulty (e.g., completing more demanding tasks) [79] or stealth (i.e., embedded in the gamified activities) [80]. These elements ensure that the experience of flow remains unaffected while also allowing educators to obtain useful information related to learners’ knowledge and skills construction. A typical approach to facilitate assessment in digital learning environments involves capturing, recording, and extracting learners’ behaviors using user (digital) logs [81]. Following completion of an assignment unit, it is important to also consider the provision of feedback. In the context of gamified activities, feedback can be provided both during (e.g., failure/replay, provision of hints/help) and after the game (e.g., reflection moments, watching others playing, review of recent activity) [82]. The nature of feedback can take multiple forms (e.g., text, audiovisual) and can be used either in isolation or as a combination [83].

3.3.5. Reflection/Discussion

Following completion of the educational tasks, educators need to provide opportunities for critical reflection and discussion [84]. As a process, it can take place outside the game context (debriefing) and may include reflective diaries, mentoring, and game critique. Beside the direct benefits that this process has for learners, it also enables instructional designers to evaluate whether the choice of games met students’ motivation and interest, the particular elements they liked more, and the aspects of the games that challenged them the most, as well as how they managed to overcome the presented challenges [85]. Discussion-based, group-oriented, or peer-to-peer reflection can be carried out with more advanced learners based on a set of predefined guidelines [86,87].

3.4. Game Aesthetics

Aesthetics, in the context of game design, refers to the player experience (Figure 4). Players experience the aesthetics first and then immerse in the game flow (dynamics, mechanics) [30]. The design of the characters and that of the surrounding environment describe the emotional responses that the game developers aimed at evoking when the players interact with the game system. Game designers have classified the fundamental aesthetics types in accordance with the emotions they evoke as follows: (a) sensation (games

centered on sensory pleasure), (b) fantasy (games rooted in imagination), (c) narrative (story-driven games), (d) challenge (games designed as obstacle courses), (e) fellowship (games promoting social interaction), (f) discovery (games exploring unknown territories), (g) expression (games focused on self-discovery), and (h) submission (games meant for leisurely pastime). Depending on the theme of the educational game more than one aesthetics approach may be utilized. Some of the most widely adopted elements are as follows.

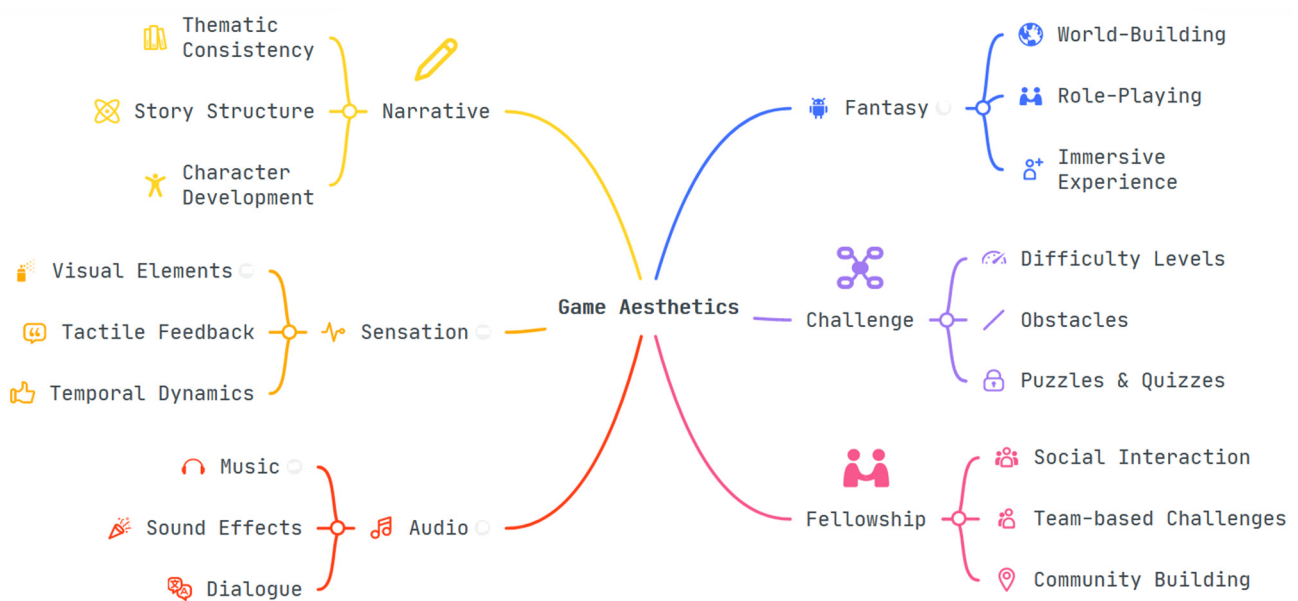


Figure 4. Overview of game aesthetics.

3.4.1. Sensation

The ‘sensation’ aesthetic refers to the tangible stimuli that a game provides to its players [88]. This encompasses factors like visual graphics, auditory elements, and tactile feedback that responds in real time. A captivating sensory layout can instantly draw a player in by fostering a comprehensive and enveloping atmosphere and by further promoting intricate interactions and dedication to the gameplay’s intricacies and educational goals. This element is particularly salient in educational games, especially where hands-on experiences and proactive discovery play pivotal roles, as seen in domains like science and engineering.

3.4.2. Fantasy

Game aesthetics often tap into ‘fantasy’ to craft compelling environments that grab players’ attention [89]. This involves creating imaginative worlds and characters that attract players’ attention, scaffold complex cognitive processes and promote deeper engagement and immersion. Incorporating these elements enhances problem solving, creativity, and critical thinking within the game. When used in education, fantasy can help ground abstract ideas, making learning more engaging.

3.4.3. Narrative

The aesthetic of ‘narrative’ is anchored in the integration of core story elements that encompass plot structures, character development, and evolving narrative trajectories [90]. An adeptly constructed narrative offers the potential to cultivate emotional resonance and player commitment, thereby inciting continued interaction and anticipation for unfolding events within the game. Within pedagogical frameworks, the narrative serves as a scaffold, contextualizing information and rendering it more resonant and enduring in the learner’s

memory. Additionally, it aids in nurturing empathy and broadened comprehension by offering players insights into diverse viewpoints and lived experiences.

3.4.4. Audio

The 'audio' aesthetic in games encompasses all auditory elements, including music, sound effects, ambient noise, and voice-overs [91]. These components shape the game's soundscape, contributing to the player's immersion, emotional engagement, and understanding of the game mechanics. Sound effects can reinforce feedback, while music sets the game's mood and pace. The use of voice acting or narration enhances narrative aspects and provides additional instructional content. In essence, a well-crafted auditory landscape not only complements but also elevates the learning experience by making it an integral part of the game design process.

3.4.5. Challenge

The aesthetics of 'challenge' revolve around the integration of tasks, puzzles, and barriers that players need to navigate to advance within the game [92]. Engaging with these challenges sharpens players' problem-solving capabilities, often resulting in a rewarding sense of accomplishment. Within educational paradigms, well-structured challenges not only serve as an active learning tool but also provide practical contexts for learners to apply their acquired knowledge. Moreover, confronting and navigating these challenges cultivate perseverance, as players frequently face the necessity of employing various strategies and demonstrating persistence despite setbacks.

3.4.6. Fellowship

The aesthetic of 'fellowship' emphasizes the game's social dimensions, promoting interactivity, collaborative endeavors, and competition among players [93]. Such dynamics might include collaborative missions, challenges specifically tailored for groups, or systems that evaluate and rank players competitively. When these fellowship elements are integrated, they can cultivate a sense of community among participants. This, in turn, enhances their engagement and deepens their commitment to the gaming milieu. In the educational context, the social interplay facilitated by fellowship not only fosters essential skills like teamwork, effective communication, and negotiation but also facilitates peer-to-peer learning, where students learn from each other and feel part of a learning community.

4. Adoption across Different Educational Levels

Across all educational stages, the overarching aim of gamification remains consistent: to offer learners a comprehensive learning environment where gamification operates as a catalyst that bolsters both individual and communal learning experiences. However, as learners progress through developmental stages, they exhibit varying cognitive skills, motivations, and interests [94]. Given these variations, the efficacy of gamification may differ based on learners' age and cognitive maturity. For optimal outcomes, instructional designers should strategically align gamification with curriculum objectives, ensuring that it augments learning rather than acting as a mere supplement. Likewise, teachers, in their pivotal role, should always consider aligning game mechanics with precise lesson goals, ensuring that the experience is both natural and unequivocally beneficial to students.

4.1. *Preschool Education*

At this foundational level, gamified activities should be playful, discovery-driven experiences, with the aim to bolster cognitive and motor skills like pattern recognition, sorting, and matching [95]. Beyond cognitive development, these activities can also foster interpersonal skills, encourage cooperative play and the act of sharing [95]. Pedagogically, this means crafting an exploratory learning environment with visual/auditory cues and tactile elements. Tools like interactive storyboards, puzzles, and badges as well as story-driven adventures, role playing, and themed challenges are essential. Curriculum-wise,

these gamified interventions should seamlessly blend with daily routines to enhance the teaching of concepts like colors and numbers [95].

4.2. Primary Education

At the primary level, gamified interventions should strike a balance between competition and cooperation, catering to the evolving learning capacities of students [96]. The focus here is to sharpen foundational academic abilities and problem-solving skills. Symbolic rewards like virtual badges, certificates, dynamic progression bars, and avatar customization options can serve as powerful motivators [96]. Pedagogically speaking, it is crucial to intricately weave these gamified components into the curriculum, ensuring that every activity resonates with subject-specific objectives. Beyond mere academic pursuits, integrating feedback mechanisms within these games can amplify the learning experience, offering students timely insights into areas warranting further attention and polishing. Curriculum-wise, these gamified tools should intertwine with core subjects, enhancing the understanding of topics such as basic arithmetic operations and foundational grammar rules.

4.3. Secondary Education

At the secondary level, the gamified experience takes on a more sophisticated and narrative-rich form, resonating with real-world contexts [96]. Emphasis in this level gravitates towards honing students' capacities for critical thinking, strategic planning, and informed decision making. A notable feature is the increased onus on learner autonomy, allowing students to chart their unique learning paths. This not only empowers them with a sense of ownership over their educational journey but also enriches their comprehension of intricate subjects. Features like branching storylines, immersive challenges, and collaborative team missions become essential tools, paving the way for multifaceted explorations. Additionally, post-gameplay reflective discussions serve as catalysts, spurring deeper analysis and fostering a collaborative learning environment where students glean insights from their experience and that of their peers. Curriculum-wise, gamified elements should be integrated in a manner that complements subjects from the arts or science, promoting explorations into significant eras or complex scientific phenomena.

4.4. Tertiary Education

In the tertiary stage, gamification matures, seamlessly merging theoretical insights with real-world applications [19]. Game scenarios should mirror challenges professionals confront in their respective fields, providing students with a simulated platform to cultivate practical skills and dexterity. While elements such as leaderboards stoke the competitive flame, they also kindle a sense of achievement and progress. Collaborative aspects, epitomized by team-based tasks, simulations, and scenario-driven assignments enrich peer-based learning. These collective endeavors promote an atmosphere of shared insights, mutual learning, and collective problem solving. An integral component is the post-game debriefing, where educators facilitate discussions, encouraging students to dissect strategies, share reflections, and jointly fine-tune their problem-solving approaches. At its core, tertiary gamification experience aims to craft a symbiotic learning ecosystem, where theoretical tenets and practical challenges converge, amplifying both individual prowess and collaborative knowledge assimilation. Curriculum-wise, such gamified interventions should simulate real-world professional challenges, aiding in subjects like business management or engineering design, offering hands-on experience in simulated environments.

5. Discussion and Prospects

5.1. Advantages

Integrating gamification into the educational landscape can revolutionize traditional learning paradigms. By tapping into the playful and competitive instincts of learners,

gamified activities can boost their intrinsic motivation and active participation [97]. This, in turn, enables educators to transform the learning process from a monotonous task to an intriguing venture. Furthermore, gamified learning scenarios often provide immediate, constructive feedback, which enables students to grasp intricate concepts, monitor their progress, and adapt their strategies as needed [98]. Moreover, games inherently offer players a measure of control over their actions, a characteristic that can be mirrored in the educational domain [99]. By promoting self-paced learning, interspersed with choices and challenges, gamification cultivates student autonomy, forming a cornerstone for personal growth. Additionally, numerous games either require or encourage cooperative gameplay, thus prompting individuals to collaborate, exchange ideas, and jointly overcome challenges [100]. The refinement of such vital life skills (e.g., teamwork, communication, collaborative problem solving) can have profound implications for learners' personal and professional growth. Lastly, the very act of engaging with digital games necessitates a degree of technological interaction. As such, it amplifies digital literacy, which is an essential skill in our increasingly digital world [99].

5.2. Disadvantages

Despite the potential advantages, educators need to remain aware of possible pitfalls. Gamification risks to over-emphasize rewards, which might inadvertently erode intrinsic motivation [101]. While the prospect of rewards can facilitate engagement, it is vital for educators to strike a balance between an innate desire to learn and external incentives. Furthermore, if gamified elements are not carefully integrated, there is a risk that games can detract from the core learning objectives [102]. Finally, the issue of equitable access to technology emerges as a significant concern [103]. Every student should have access to the necessary technological resources. Students from low-income societal or geographically marginalized backgrounds could find themselves in a disadvantageous position, which could potentially deepen the existing educational divides even more.

5.3. Implementation

Effective implementation hinges on multiple factors. Firstly, ethical considerations are paramount. Throughout the design phase, gamification designers should remain acutely conscious of ethical guidelines, including justifying their choices and following the broader societal views on gamification ethics [104]. Moreover, resource implications should not be overlooked. Gamification demands a spectrum of resources, including not only monetary outlays for technology procurement and upkeep but also the allocation of time for educator training and content creation [105]. Technological limitations must also be considered. Addressing hardware and software competencies, ensuring stable internet connectivity, and catering to the varying digital proficiency levels of users are pivotal for a seamless gamified learning experience [106]. Lastly, as we delve deeper into the digital realm, the protection of student data becomes increasingly paramount [107]. Ensuring robust data security and upholding student privacy warrants attention during both the crafting and execution of gamified endeavor.

Pedagogically, gamification should not be implemented in isolation but rather integrated thoughtfully into the broader educational framework. The primary goal of gamification in education is to enhance learning by incorporating elements of enjoyment. However, enjoyment should not overshadow the educational intent. Therefore, an effective gamified activity should seamlessly integrate entertainment with the learning objectives in order to provide an experience that is both engaging and instructive [108]. Beyond this, teacher training emerges as a linchpin. For gamification to truly take root, educators must undergo holistic training, equipping themselves to steer the technological helm, pivot as dynamics evolve, and troubleshoot emerging challenges.

5.4. Challenges

The transformative potential of gamification in education is not without its complexities, particularly in the realms of player engagement and technical infrastructure. These challenges are critical to comprehending the full scope of gamification's impact and limitations.

Player engagement is a multifaceted construct that goes beyond mere participation, encompassing emotional, cognitive, and behavioral dimensions [109]. Designing gamification elements that resonate with a diverse learner profile is a significant challenge. A one-size-fits-all approach may lead to disengagement among learners who do not find the gamified elements motivating [110]. Moreover, sustaining engagement over time presents another hurdle. While initial engagement may be high, the novelty effect can wear off, leading to decreased motivation [97]. Dynamic gamification techniques that adapt to learners' progress and preferences are essential to sustaining engagement [111].

On the technical side, implementing gamification at scale demands a robust and secure infrastructure. This involves not only software development but also integration with existing educational technologies [112]. A multidisciplinary approach, involving expertise in programming, instructional design, and educational psychology, is often required. The infrastructure must also be capable of collecting and analyzing large volumes of data for real-time feedback and dynamic adaptation [113]. This can be resource-intensive and necessitates robust backend architecture and data analytics capabilities. Equitable access to technology, particularly for learners from socioeconomically disadvantaged backgrounds, is another concern that must be addressed [114].

Given these challenges, future research should focus on developing adaptive gamification frameworks sensitive to individual differences and contextual factors. Likewise, empirical studies are needed to understand the long-term effects of gamification on engagement and learning outcomes. Finally, research could explore cost-effective and scalable solutions for implementing gamification in diverse educational settings.

5.5. Mixed Reality, Artificial Intelligence, and the Metaverse

In the realm of education and training, the rise of advanced computer graphics and game engine software, and the development of embodied, immersive interfaces have allowed practitioners to explore complex playful and gameful approaches to system architecture and instructional design towards interventional sophistication. Technologies such as AR and VR have been utilized to craft gamified simulations, role-plays, and games with serious purposes [115]. Serious games such as escape rooms can be designed in AR and VR to provide immersive learning experiences [116] both in science and humanities [8,117].

The advent of large language models, such as GPT-3, has ushered in a new era of personalized and dynamic gamification in language education. These AI-driven models enable the creation of adaptive quizzes, interactive conversations, and real-time feedback mechanisms, thereby enriching the gamification landscape [118]. The integration of such models into educational platforms can significantly enhance learner engagement and educational outcomes, aligning well with the future research agenda of shifting from individualistic incentives to communal motivation.

The Metaverse, as a seamless spatial computing bridge between physicality and virtuality, can provide a new frontier for meaningful integration of gamification practices in several fields and sectors [119]. As technology advances, it is expected that this innovative solution will be mediated by smart wearable devices, headsets, and even brain-computer interfaces with multiple sensors. These devices can provide additional user inputs that can be quantified and shared. The utilization of multi-user, social virtual worlds in the Metaverse is aligned with the proposed future gamification research agenda encompassing individualistic incentives towards communal motivation and collaborative engagement [10]. At the same time, the enhanced possibility to harvest users' emotions and reactions raises serious ethical questions around data privacy that need to be addressed to ensure user approval and mass adoption [120].

6. Conclusions

The successful adoption and advancement of gamification in educational settings hinge significantly on the perspectives of its primary end-users. Understanding these viewpoints is not only crucial for the effective design and implementation of gamification strategies but also for their widespread acceptance and sustainability.

From the learners' perspective, the allure of gamification often lies in its capacity to make learning more engaging. However, attitudes can vary based on individual experiences and educational goals. Some may find gamified elements motivating, while others may see them as distractions.

Conversely, educators' willingness to integrate gamification is influenced by their perceptions of its efficacy, ease of use, and the resources required for implementation. While some view it as a potent tool for enhancing student engagement, others may hesitate due to concerns about resource allocation and effectiveness.

To reconcile these varying perspectives, a co-design approach involving both learners and educators can be invaluable. Such an approach should include feedback loops and iterative design processes to fine-tune the gamification elements. This would ensure that the strategies employed are not only pedagogically sound but also resonate with the end-users' needs and preferences.

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