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Article

Gamification Equilibrium: The Fulcrum for Balanced Intrinsic Motivation and Extrinsic Rewards in Electronic Learning Systems

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Abstract

In this study, we developed a concept for balancing extrinsic rewards and intrinsic motivation in gamified learning systems by applying the principles of equilibrium found in first-class levers. Despite the growing interest in gamification as a tool to enhance motivation and engagement, empirical findings are inconsistent, and there is no unified agreement among researchers on its effective implementation. Gamification employs game design elements and principles to enhance user experience in various contexts, including the field of education and learning. However, its application in Information Systems (IS) and beyond has revealed inconsistencies and challenges that this study aims to explore. Our review identifies an overreliance on narrow models and shallow design (focusing solely on badges, points, and leaderboards, known as "BPL gamification") as contributing factors to the failure of some gamified systems. These approaches can lead to an imbalance between extrinsic and intrinsic motivation, resulting in the "Overjustification effect," a phenomenon that undermines the effectiveness of gamification. By providing a more nuanced understanding of how to select and apply game elements, this study aims to mitigate these challenges and promote a more successful implementation of gamification, avoiding common pitfalls and clichés in design.

1. Introduction

Over the last decade, the fields of information systems and computer science have witnessed tremendous advancements. One such development is the harmonious integration of hedonic and utilitarian information systems, resulting in the rise of "Gamification."[1], [2] This concept has swiftly established its significance in the areas of "motivation," "engagement," and "behavioural change" solutions [1], [3]–[6]. Utilitarian information systems (UIS) are productivity-oriented, utility-centered tools primarily utilized by organizations for value creation [7]. In contrast, hedonic Information systems (HIS) are pleasure-driven and entertainment-oriented tools, generally employed for leisure and fun [8]. Gamification arises when elements and principles of game design, typically found in video games, are integrated into a utilitarian learning system. In essence, gamification is defined as the application of game elements and principles in a non-gaming environment [9]

The concept and origin of gamification was an inspiration from video games and how it keeps players engaged [9]–[11]. Although gamification is relatively new in both research and practice (appearing around a decade ago [9]). Yet, in its short span, gamification has ascended rapidly, emerging as a potent catalyst for motivation and engagement in education [12]. This apparent potential has facilitated gamification's widespread adoption across multidisciplinary domains such as marketing [13] , human resources [14], [15], tourism [16], e-commerce [17], [18], medicine [19], and more.

Despite the promise of gamification, growing concerns, and challenges cast shadows over its effective utilization [20]. A significant issue arises from the inconsistent empirical outcomes associated with its application in learning environments [21], [22]. For example, gamified educational systems do not always result in improved student outcomes, despite the anticipated benefits [1], [23]. This reality has led researchers to dig deeper into the conditions under which gamification can be most beneficial [24]. The effectiveness of gamification is influenced by various factors, including but not limited to, design quality [25], theoretical grounding [26], [27], standardization [28], individual differences [1], [29], and contextual dependencies [30]. This study, however, places a keen emphasis on the roles of intrinsic and extrinsic motivations in gamified learning systems. Intrinsic motivation refers to engagement driven by personal interest or satisfaction in the task itself, whereas extrinsic motivation pertains to behaviours incentivized by external rewards [31], like points or badges. Striking an optimal balance between these two forms of motivation remains a formidable challenge in the design and implementation of gamified systems [11], [22], [24], [32]. Overemphasis on extrinsic rewards can undermine intrinsic motivation [33], a phenomenon known as the "overjustification effect" [34]. Such an imbalance can result in reduced engagement once the external rewards are removed [32]. Concurrently, empirical outcomes on the effectiveness of gamification are incongruent. Some studies suggest that gamification enhances motivation and improves learning outcomes [35], while others contend that its impact is context and design-dependent [1], [20]. Furthermore, designing systems that cater to diverse motivational profiles presents another challenge [36]. While some users may be driven by competition and comparison, for instance (extrinsic motivation), others may find motivation in self-improvement and mastery (intrinsic motivation [37]).

In light of these challenges, this study seeks to explore the complexities of intrinsic and extrinsic motivation in the gamification of learning systems. The goal is to understand how these critical factors can both hinder and enhance gamified learning solutions and propose a balanced approach for integrating these two forms of motivation into the design of gamified learning systems. This supposed balanced approach is what we refer to in this study as the “Gamification Equilibrium” Concept.

1.1 Motivation in Gamification

Central to the design and implementation of nearly all gamification applications is the concept of motivation, making its understanding crucial to analyzing the outcomes, effectiveness, potential pitfalls, and overall dynamics of gamification [38]–[40]. Several theories of human motivation, such as Flow Theory [41], Self-Determination Theory (SDT) [42], and Self-Efficacy Theory [43], along with Information Systems (IS) theories like the Technology Acceptance Model [44], have been utilized to provide theoretical frameworks for gamification applications across various contexts [45]–[48]. Among these, SDT, a theory explaining the degree to which behaviour is self-motivated, is often used to guide gamification [49].

The SDT is the widely used theory in gamification [47], [50]–[53]. SDT as a theory used in gamification, emphasizes satisfying needs for competence, relatedness, and autonomy to stimulate intrinsic motivation [42], [47]. However, blindly applying SDT risks ineffective or demotivating implementations if those needs are not properly supported [47], [54]. Other theories like the Goal-Setting Theory provides structure for productivity gamified apps [53]. For education, ARCS Model targets attention, relevance, confidence, satisfaction [55]. This illustrates the context-dependent nature of motivation theories for gamification [45]. While valuable individually, exclusively applying one theory may likely overlook the multidimensional complexity of human motivation [11], [51], [56]. An integrative approach combining multiple theories or frameworks allows designers to target outcomes like learning motivation, health behaviour change, or performance improvement more consistently [57], [58].

Flow Theory, first proposed by [59], is an influential motivational theory often applied in gamification design also. The theory states that individuals achieve a mental state of "flow" when they are fully immersed in an activity, characterized by intense focus, a sense of control, loss of self-consciousness, and an intrinsic sense of reward [41]. In gamification, Flow Theory has frequently been used to create engaging, enjoyable experiences that deeply captivate users' attention [4], [60], [61]. To practically implement Flow Theory in a gamified system, designers often focus on using befitting game elements to match the skill level of users (or learners) with challenge at progressive levels of gamified activities. This balance ensures that a 'flow state' is achieved and maintained throughout the gamified gamut [60]. For example, game elements like challenging tasks, immediate feedback, clear goals, and empowering users can facilitate flow, thereby enhancing engagement and intrinsic motivation [62], [63]. However, some researchers caution that achieving flow does not guarantee other intended outcomes like learning or behaviour change [64], [65].

While flow-inducing features may promote enjoyment, designers must carefully consider how Flow Theory aligns with their specific aims [53], [66]. For instance, a study by [64] found that a gamified learning system optimized for flow increased engagement but not comprehension. Thus, Flow Theory may complement, but not replace, other motivational models like Self-Determination Theory [66]. Integrating multiple theories can provide a more comprehensive framework tailored to desired outcomes [53], [66]. In a nutshell, Flow Theory offers useful insights into enhancing users' engagement and enjoyment. However, designers should thoughtfully select and integrate theoretical models to suit their particular objectives and context [53], [65]. Flow Theory alone may not foster outcomes like learning or behaviour change, requiring complementary motivational frameworks.

Again, understanding user acceptance and adoption of technology has always been a significant aspect of implementing technological innovation [67], [68], including gamified learning platforms. One such framework that has been widely used to evaluate technology acceptance is the Technology Acceptance Model (TAM) proposed by [44]. TAM has two key constructs: perceived usefulness (PU) and perceived ease of use (PEOU). This model posits that these constructs significantly influence a user's attitude towards using a technology, which subsequently impacts the actual usage of the technology. In the context of gamified learning technologies, TAM has been used to design gamified systems [69], identify influential factors that could enhance the adoption of these technologies [70], and predominantly, to predict user acceptance [71]–[74]. For instance, [75] extended TAM by incorporating factors from Self-Determination Theory, such as autonomous motivation and controlled motivation, to examine Chinese EFL learners’ acceptance of gamified vocabulary learning apps. They found that autonomous motivation positively predicted PU and PEOU, while controlled motivation only positively affected PU. Moreover, the original TAM has been expanded in the context of gamified learning by including other factors like enjoyment and task-technology fit. TAM has also been expanded by including other variables, like enjoyment, that are intrinsically associated with gamified learning. Although not in gamification, [76] integrated hedonic enjoyment with TAM to explore the acceptance of online games. Their results revealed that enjoyment positively influenced PU and PEOU. However, as [26] highlighted, TAM primarily focuses on utility perceptions and might not account for the motivational appeal and enjoyment of gamification fully. This observation underscores the need for further empirical studies that investigate the intersection of TAM and gamification, particularly how different gamification elements influence TAM constructs.

Having considered the state of gamification literature, this paper proposes a concept for balancing extrinsic and intrinsic motivation in learning systems. This is because one of the common conundrums of gamification success today is the imbalance of extrinsic motivators and intrinsic motivators [32]. Modern gamifications often rely heavily on extrinsic rewards [21], [22], [33], which have been reported to likely undermine intrinsic motivation and lead to gamification failure [53], [77], [78]. Therefore, there's a need to develop ways to help balance extrinsic and intrinsic motivation. Studies have shown that the presence of specific game design elements can have profound effects on psychological need satisfaction and motivate the user [1], [54]. Building on these insights, we leverage the dynamics of first-class levers to propose a balancing concept for intrinsic and extrinsic motivators in gamified learning systems.

The remainder of this study is structured into four main sections. Section 2 highlights and expands on state and challenges of intrinsic and extrinsic motivation in learning gamification, and the challenges of superficial gamification. Section 3 details about our conceptual framework for balancing extrinsic and intrinsic rewards. Section 4 highlights the implication of our study and the pathways for future studies. Section 5 summarises and concludes the study.

2. Intrinsic and Extrinsic Motivation

Human motivation serves as a critical component in the development of gamification applications [79]. From a psychological perspective, motivation is often classified into two broad categories: intrinsic and extrinsic [31]. Intrinsic motivation is defined as the performance of an activity for the inherent enjoyment, satisfaction, or sense of personal challenge and accomplishment it provides [31], [42]. We characterized this kind of motivation as a "want to" drive and is internal, originating within the individual. For example, when an individual voluntarily chooses to perform an action because they find the activity itself inherently rewarding, this is an instance of intrinsic motivation. The individual is guided by their personal interest or enjoyment in the task itself, rather than external factors or rewards. On the other hand, extrinsic motivation refers to engaging in an activity in anticipation of an external reward or to avoid a negative consequence [31]. We believe this kind of motivation can be described as a "need to" or "have to" drive, as it is externally regulated. For instance, a student studying solely to earn good grades or avoid failure is extrinsically motivated. Thus, we can say such student is driven by "need to" or "have to" motivation. Practically, when an individual feels he/she “wants to” perform an activity, that decision is volitional and free from any external coercion, reward, or penalty. Hence, it is intrinsic. Conversely when an individual feels he/she “needs to” or “have to” perform an activity, then there’s an external factor at stake, and that factor necessitates such activity to be done whether the individual enjoys it or not. Hence, it is extrinsic. In the instance of the student, such student may not derive inherent joy from the learning process, but he/she is motivated by the external reward (good grades) or avoidance of a negative outcome (failing).

The interplay between intrinsic and extrinsic motivation is complex, with each type of motivation having its strengths and potential pitfalls in different contexts. Understanding the nuances of these motivational types, alongside those of other motivational models can be pivotal in the effective design and implementation of gamification applications across various settings [32], [80]–[83]. Despite the clarity between the two, distinguishing intrinsic from extrinsic motivation in practice isn't always straightforward [31], [84], [85]. Some researchers have developed methods to identify the type of motivation present in individuals [31], [83], [86]. However, one practical litmus test we suggest for discerning the type of motivation is examining stability in the presence or absence of rewards: if motivation remains stable without rewards, it is likely intrinsic, but if it wavers—increasing with rewards and decreasing without— it is likely extrinsic.

Now, some researchers have highlighted that intrinsic and extrinsic motivation can coexist without contradiction in ideal circumstances [83], [87], [88]. Several studies have reported that introducing extrinsic motivators, such as points and badges, can potentially dampen the intrinsic motivation in individuals [11], [53], [77], [78], [89], [90]. This raises critical questions: "When should extrinsic motivators be applied in gamification?" "When do extrinsic motivators overstep their boundaries?" "Under what circumstances does an extrinsic reward undermine intrinsic motivation in gamification?" "How can intrinsic and extrinsic motivators be harmoniously integrated in a gamified system?" "Can a system be considered gamified if it relies solely on extrinsic motivators?"

The general consensus among researchers suggests that relying solely on extrinsic motivators does not create effective gamification, especially in academic settings [32], [54], [91], [92]. As such, it is becoming increasingly clear in research that the assertion that gamification can be wholly constituted by extrinsic motivators is not valid, particularly within educational contexts [32], [64]. In many current academic and educational systems, there is a significant emphasis on reward systems, such as grades or class rankings [61], [93]. These systems frequently translate into the realm of gamification, with elements like points-scoring, leaderboards, and performance-based rewards mimicking traditional academic reward structures. However, these external rewards are not typically considered the core elements of gamification (Pankiewicz, 2016). Hence, the relationship between intrinsic and extrinsic rewards in gamification presents a complex and vital area for further research, with the goal of understanding how to balance and effectively integrate these different types of motivators in gamified learning contexts.

Again, the application of gamification and the types of rewards employed can significantly vary across different contexts. The effectiveness of intrinsic versus extrinsic rewards in gamification is a multifaceted issue, heavily influenced by the specific context and user population [1]. In educational settings, the introduction of extrinsic rewards such as badges and leaderboards can foster a competitive environment and increase engagement among students [61]. However, as established earlier, an overemphasis on these extrinsic rewards can inadvertently undermine intrinsic motivation, potentially leading to decreased long-term engagement [32], [85]. Conversely, in the corporate world, gamification strategies often leverage both intrinsic and extrinsic motivators to boost employee productivity and engagement [54]. Extrinsic rewards, such as bonuses or public recognition, can incentivize employees to perform better. Simultaneously, intrinsic motivators like personal growth, mastery of new skills, or the joy of problem-solving can sustain long-term engagement [31]. Health and wellness applications present another unique context. These platforms often rely on intrinsic motivation, promoting the inherent satisfaction of healthy behaviours and personal achievement [94]. However, they may also employ extrinsic rewards, such as badges or social recognition, to encourage users to maintain their activities. In the realm of marketing and consumer behaviour, gamification techniques often hinge on extrinsic rewards, such as discounts or loyalty points, to drive consumer engagement [95]. Yet, the joy of interacting with a well-designed gamified system can also serve as an intrinsic motivator that drives repeated engagement [96].

In a nutshell, the balance and effectiveness of intrinsic and extrinsic motivators in gamified systems can vary dramatically depending on the specific context. To maximize the benefits of gamification, it's crucial for designers to carefully consider the intended audience, the nature of the activity, and the desired outcomes, tailoring the motivational strategies accordingly [9], [97].

2.1 Dimensions of Extrinsic Motivation

Type of Extrinsic Motivation	Nature of External Contingency	Underlying Reason for Behavior	Example
External Regulation	Consequences, incentives, compliance	To receive or avoid a consequence; to fulfill an external requirement	"I avoid making prejudiced comments so that other people will think I'm nonprejudiced"
Introjected Regulation	Feelings of internal pressure; to avoid guilt or to boost the ego	Because it "should" be done	"I avoid acting in a prejudiced manner because I would feel bad about myself if I didn't"
Identified Regulation	Personal valuing of a behavior, sense of importance	Because it is important	"I avoid being prejudiced because it is an important goal"
Integrated Regulation	Expression of self and identity; congruence with self and other values	Because it reflects core values and self/identity	"I avoid being prejudiced because I see myself as a nonprejudiced person"

Figure 1 Types of extrinsic motivation applied to the example of motivation to regulate racial prejudice (Adapted from [98])

Whilst it is true that extrinsic motivation pertains to behaviour driven by external rewards or pressures, there are several types of extrinsic motivation (Figure 1), according to Self-Determination Theory (SDT), a psychological framework developed by [42], that are organized along a continuum of self-determination. They range from external regulation, the least autonomous, to integrated regulation, the most autonomous. These types include external, introjected, identified, and integrated regulation [31].

2.1.1 External Regulation

External regulation is the least autonomous form of extrinsic motivation. In this category, individuals engage in a behaviour to obtain a reward or avoid a penalty. For example, as seen in Figure 1, a person might avoid making prejudiced comments so that other people will perceive them as non-prejudiced [98]. In an educational context, this might involve students studying to obtain high grades or to avoid parental disapproval [31]. In terms of gamification, this external regulation is often the result of rewards or penalties implemented to drive behaviour. Platforms like Kahoot!, for instance, use points, badges, and leaderboards (PBLs) to motivate students to engage with learning material [99], while fitness apps like Fitbit or Strava offer badges and rewards for accomplishing physical activity goals [100].

2.1.2 Introjected Regulation

Introjected regulation is characterized by behaviours motivated by internal pressures, such as guilt, shame, or contingent self-esteem [101]. The actions still feel externally imposed, but the source of pressure comes from within. Figure 1 illustrates this with an individual who avoids acting in a prejudiced manner because they would feel bad about themselves if they didn't. A common academic example of introjected regulation is when students study hard to avoid feelings of guilt rather than because they enjoy the act of studying [102]. Gamified systems can harness this type of regulation by using mechanisms that generate internal pressures. For instance, in language-learning app Duolingo, the desire to maintain a "streak" of daily use can act as a powerful motivator for continued practice [103].

2.1.3 Identified Regulation

Identified regulation represents a more autonomous form of extrinsic motivation, where the individual recognizes the value of a behaviour and accepts its regulation as their own [101]. As an example from the racial prejudice (Figure 1), an individual might avoid being prejudiced because they see it as an important personal goal. In academia, students may study diligently because they understand the significance of good grades for their future career [104]. Gamification can tap into this type of motivation by tailoring experiences to align with personal goals. For instance, the Nike Run Club app's personalized coaching and fitness plans reflect the health benefits of regular exercise, aligning app usage with users' personal fitness objectives [105].

2.1.4 Integrated Regulation

Integrated regulation is the most autonomous form of extrinsic motivation, where the behaviour aligns with an individual's broader life goals and self-identity [101]. Again, from the racial prejudice example of Legault et al. [98] (Figure 1), we see that an individual driven by Integrated regulation avoids being prejudiced because they see themselves as a non-prejudiced person. This type of motivation resembles intrinsic motivation in its autonomy, despite still being externally driven. In the realm of gamification, integrated regulation can be achieved by promoting deep engagement and mastery [106]. For instance, Minecraft, although a game, often used in educational contexts [107], offers opportunities for creativity and problem-solving that align with broader educational goals, fostering deep engagement in the game that aligns with students' broader objectives of learning and personal development.

While these forms of extrinsic motivation are not mutually exclusive and can coexist within an individual, they represent different levels of autonomy and internalization that can vary across different activities and contexts [31].

2.2 The Bisect of Learning, Motivation, and Gamification

Learning and motivation are closely related and complementary [108], [109]. Success in any learning activity is tantamount to the presence of motivation [110], [111]. As stated by [112] the concept of e-learning is subject to constant change. It is difficult to come up with a single definition of e-learning that would be accepted by the majority of the scientific community. Nonetheless, it is believed that different understandings of e-learning are conditioned by particular professional approaches and interests. Thus, electronic learning as coined by [113] is a kind of learning that is supported by digital electronic tools and media. Teo & Gay (2006) defined e-Learning as the use of ICTs to enhance or support learning and teaching. The [115] defined e-learning as information and communication technologies used to support students improve their learning. Now, regardless of the stance with which e-learning is defined, learning itself is an activity that calls for strong presence of motivation [116], and e-learning calls for even stronger motivational qualities because students are mostly alone in their efforts in such environment. In fact, studies such as that of [117] have for long shown that the quality of motivation is more important for educational outcomes than the quantity of motivation, and of course this is where the extrinsic and intrinsic motivational qualities come to play. [31] found that intrinsic motivation remains an important construct, reflecting the natural human propensity to learn and assimilate. Hence, relative to the quality of motivation in learning, this then means that intrinsic motivation should be the choicest of the two when seeking for an effective e-learning experience [118], [119]. Gamification was introduced in learning as an approach to foster motivation and engage students in learning activities [120] However, recent trends in gamification have deviated from this intrinsic pattern for several reasons (such as the ease of implementing extrinsic rewards; [32], [121]). Gamification has often leaned toward extrinsic motivational attempts, with earning points, badges, and other virtual rewards becoming commonplace [1], [33], [47]. A few reasons for this deviation include the relative ease of designing systems based on extrinsic rewards [61], the immediate engagement that these rewards can provide [32], [77], and the difficulty of measuring and quantifying intrinsic motivation [1]. In addition, many gamification studies have primarily focused on short-term effects [33], [77], [122], which tend to highlight the immediate impact of extrinsic rewards, but do not capture the long-term benefits of intrinsic motivation [96]. Again, many gamification strategies have adopted a competitive structure (e.g., leaderboards), which naturally leans towards extrinsic motivation [93]. This shift towards extrinsic motivation in gamification is noteworthy and raises questions about the balance between intrinsic and extrinsic motivation in designing gamified solutions for learning. Some experts refer to this process of arbitrarily rewarding users with points and virtual elements as mere “pointification” and not gamification at all [32], [122], [123]. In fact, the term "pointification" was originally devised as a form of critique to mock rudimentary gamification strategies overly focused on rewards. However, its interpretation has evolved over time, with some studies now recognizing it as even a subset of gamification. Specifically, [124] research puts forth the notion that "pointification" includes elements such as "skillpoints" and "leaderboards." These components are geared towards engaging the extrinsic motivation of learners, emphasizing the pursuit of rewards and rankings. Despite its initial conception as a term of mockery, "pointification" has been recast in the light of a nuanced, motivation-centric approach within the broader spectrum of gamification. Research shows, as we have established previously, that incorporating only extrinsic motivators such as points can actually detract from learning and motivation [125]. A study by [77] discovered that intrinsic motivation can be hampered when rewards are given to learners who were initially motivated. Again, the seminal study by [126] although not in a gamified setting. The study demonstrated that expected extrinsic rewards can undermine intrinsic motivation, as observed in preschool-aged children whose interest in drawing decreased when they expected to receive a "good player" certificate for this activity. This, they referred to as the “Overjustification effect”; a phenomenon where intrinsically motivated individuals start getting rewarded (externally) for doing what they love to do, and then suddenly lose interest in the activity when the rewards are stopped such that they become demotivated and no longer feel interested in doing what they once loved to do [126]. This is also in line with the cognitive evaluation theory which predicts that when a reward is seen as controlling it can cause one to feel less competent and in control, which decreases intrinsic motivation [127]. Similarly, [77] reported using extrinsic rewards (leaderboards, badges) in a gamified longitudinal study. Their findings showed that students in the gamified classroom were less intrinsically motivated and in turn earned lower exam scores than those in the non-gamified classroom. This goes to suggest why many gamifications today may be failing. Hence, in order to develop intrinsically valuable gamified systems, research suggest that content must be gamified by mindfully incorporating immense game elements such as characters, stories, challenges, and levels [32], [33]. Now, it is important to note that extrinsic motivation has its place in gamification. Just as Lepper (1973) stated, that "extrinsic rewards in themselves are neither good nor bad, there are only good or bad uses of them." Thus, on these premises, it suggests that, merely expecting learners to earn (extrinsic) rewards alone such as badges and points on a system is not proper gamification [128], [129], at best it is shallow gamification [32], [130]–[133].

2.3 The Overjustification Effect in Gamification

The overjustification effect, a psychological theory initially proposed by [126], illuminates the paradoxical outcome when extrinsic rewards are provided for intrinsically motivated activities, resulting in a decrease in intrinsic motivation. In such situations, the individual's perceived motivation for participating in the activity shifts from inherent enjoyment to the external rewards, overshadowing the intrinsic motivation [126], [127]. This effect has been substantiated by extensive research across diverse fields [85], [134].

In the realm of gamification, the interplay between intrinsic and extrinsic motivation poses a critical concern, particularly the overjustification effect [51], [135]. This occurs when the excessive emphasis on extrinsic rewards, such as points, badges, and leaderboards, inadvertently undermines the intrinsic motivation of the learners [77], [136]. For instance, Hanus and Fox (2015) conducted a study revealing that university students enrolled in a heavily gamified course exhibited lower intrinsic motivation and poorer exam performance compared to their peers in a non-gamified course. This finding echoes other studies that reported similar adverse effects of excessive extrinsic rewards on gamified learning environments [129], [137], [138].

Further evidence of this overjustification effect was provided by a recent large-scale empirical study, which showed a decline in user contributions to a community question answering website after a time-limited promotional gamification scheme ended [135]. This signifies that the overemphasis on extrinsic rewards may not sustain user engagement in the long term. This pattern is not limited to academic or online community settings. A study by [136] demonstrated this effect in a tourism context. The study, conducted in a maze park, examined the impact of two gamification elements - letterboxing and external rewards – on psychological outcomes. The results indicated that letterboxing, which stimulates intrinsic motivation, had a significant positive impact. In contrast, external rewards had limited positive effects and even undermined the positive effects of letterboxing. This suggests that even in leisure activities, the overemphasis on extrinsic rewards could diminish intrinsic motivation and thereby affect overall engagement. In light of these findings, it is evident that a balanced and thoughtful approach to the use of extrinsic rewards in gamified learning and experiences is crucial. Careful calibration is essential to prevent the overjustification effect from overshadowing intrinsic motivation, which is central to sustaining engagement and facilitating beneficial outcomes.

2.4 Shallow Gamification: A Dilemma in Gamified Learning

The study by [132] was the first to coin the terms "shallow gamification" and its counterpart "deep gamification", illuminating two distinct yet interconnected strategies within the broader realm of gamification. Shallow gamification, as he defined it, primarily employs extrinsic motivators such as points, badges, and leaderboards. Although these superficial gaming elements may initially captivate learners, providing immediate gratification, the strategy often falls short in fostering enduring motivation and long-term learning outcomes [61], [139]. Such findings align with those by [77], and [125], who documented declines in student interest, effort, and performance over time when overly reliant on incentive-based gamification strategies. Lieberoth's concept of shallow gamification brings these concerns to the fore, underscoring the need for gamification that transcends the superficial allure of extrinsic rewards [132].

On the other side of Lieberoth's dichotomy, deep gamification integrates comprehensive game mechanics that stimulate intrinsic motivation, fostering meaningful learning experiences and sustained engagement [132]. Scholars such as [32], [33] champion this approach, arguing that a balanced mix of intrinsic and extrinsic motivators can more fully harness the potential of gamification in enhancing motivation and learning [58], [128]. Empirical research from [133], [140] provide case studies that underline this necessity. Despite initial successes of shallow gamification in Santos' Linear Algebra course, concerns about its sustainability became evident, echoing the critiques of an over-reliance on extrinsic motivators. Mozelius, too, emphasizes the need for deep gamification in fostering lasting engagement in higher education, advocating for a more profound, intrinsically motivating approach.

In essence, the terms "shallow" and "deep" gamification, as introduced by [132], offer valuable lenses through which to critically assess and refine gamification strategies. By moving beyond a superficial focus on extrinsic rewards and towards a more balanced, comprehensive approach, deep gamification promises to foster both immediate engagement and long-term learning outcomes. This synthesis of strategies, nuanced by Lieberoth's contributions, serves as a roadmap for evolving gamification practices that authentically enhance both motivation and learning.

2.4.1 Contrariety of Gamification

Gamification has been present and widely discussed for more than a decade now [9], [22], [141] However, as we have discussed thus far, it would be inaccurate to say that the concept is well-established or universally agreed upon [21]. There are as many failed and inconclusive findings in the literature [142]–[145], as there are successes [146]–[148]. Several factors are responsible for this paradox, but of course the inconsistencies of empirical findings reveals that there is much unknown about applying gamification to learning. In essence, a knowledge gap exists on how to appropriately select, and effectively apply befitting “game elements” and “game principles” to systems and processes. This is an area where we believe more empirical studies are needed if at all gamifications will be solidly entrenched in the mainstream.

2.5 The Plaque of BPL Gamification

The ad hoc use of badges, points, and leaderboards, often referred to as the “BPL triad,” or “BPL Gamification” is a major trend in gamification [149]–[151]. As a result of this ad hoc gamification method, a large portion of the educational gamification studies today are driven by an innocent but erroneous presumption that gamification in learning is all about conjuring a “seemingly appealing” combination of game elements to be applied on a system [22], [54], [149], [152], [153]. Such costly presumption is what has led to the controversial findings we see today in gamification literature [21], [22], [27], [32], [133], [152]. Very few studies convincingly justify their selection of game elements in a gamification project [21], [22]. In this light, it is essential to note that game elements are the crux of gamification; they make or break any gamification project [40]. As such, ineffective or failed gamification (especially in learning) can be traced down to this “game element” problem [154]. In fact, the plethora of game elements available in literature remains scattered, largely unclassified [9], [155], [156], and without systemic taxonomies for proper understanding of their roles and effect in gamification [157], [158]. Thus, it makes it quite challenging for designers and researchers to know and understand “what game element does what”? and “what game element fits where”? Hence, gamification designers and researchers have, to a large extent, been surmising about which game element to incorporate and why it should be incorporated. As such, gamification research till date still lacks coherence in research models, frameworks [21], and a sense of consistency in the variables and theoretical foundations used [81], [159]. In fact, a present-day cliché that best explains this issue is the arbitral use of common game elements such as “badge”, “points”, and “leaderboards” in any and every gamification project [22], [160]. This is widely nicknamed “BPL gamification” amongst researchers and practitioners [153], [161]. Now, [162] highlighted that developing and implementing a successful gamification is a challenging task. As such, the “BPL” concept was largely born and nurtured out of laxity and frivolity by developers, researchers, businesses, institutions, instructors, and several stakeholders who desire to benefit from the outcome of gamification (i.e., motivation) without having to put in serious effort to build a befitting one [22], [163]. The thinking behind the “BPL” gamification is that, adding “point,” “badges”, and “leaderboard” to any system, activity, business, or process will miraculously turn it into an effective gamification and thus motivate individuals, of which the vast empirical findings disprove that [21], [22], [152]. Now, the “BPL gamification” in itself, is not illicit, but it is grossly imprecise considering the vast array of unique studies and contexts that try to adopt it as a diacatholicon [20], [32], [153], [164]. This again is in line with what [165] stated, that “one size of gamification isn’t suitable for all”. Hence, the glorified so-called “BPL gamification” would not befit some learning settings enough to induce the necessary change in behaviour desired [153]. In fact, studies such as that of [154] highlighted that for an effective gamification in learning, developers must be selective and purposeful in using game elements such that it aligns with the desired learning goals [22], [132], [166]. This is because as [154] stated, “Poorly applied game design elements, may undermine learners’ innate motivation.” Now, it is essential to understand that just as other game elements in their appropriate jurisdiction, the BPL game elements are powerful and effective (if placed accordingly). However, blindly apply them to a system or an activity without a thorough understanding of the context and the target users will turn it into a bumf [157], [158]. This is the story of several gamification attempts today [167].

2.6 A Sure Foundation; Intentionally Gamified

It is crystal clear now that there is a need for several considerable factors when selecting and applying game elements to learning (systems and processes) for consistent and successful results. We believe, such factors amongst others, should include preliminary inquisition as to “What are the specific goals we want to achieve through this gamification? Are we focusing on increased motivation, engagement, enjoyment, improved achievement, or satisfaction? What are the measurable objectives tied to these goals?”; “Who are the target learners for this gamified experience? What are their demographic characteristics, learning styles, and preferences?”; “What kind of gaming influence or emotion (e.g., competition, challenge, or relationship) do we want to arouse or invoke in the target learners? How does this align with our objectives?”; "What intrinsic motivations might drive the target learners to engage with this gamified experience? How can we cultivate and leverage these internal drives? What extrinsic motivations might appeal to the target learners? How can we provide external rewards or incentives that align with the subject or course?" and “What is the target learners' average perception towards the concept of gamification and prospective individual game elements? How can this insight inform our design and selection of game elements?”[11], [168]. Factoring such inquisitions beforehand will help gamification developers create a solid systematic basis for selecting suitable game elements that should be applied to any learning system, thereby yielding more positive results. Sadly, only a handful of studies take such factors into account and yield success, and even amongst those who consider these learner-factors, only a few do so thoroughly. Most do so shallowly [133], [157], [169]. Therefore, to bridge the gap, we recommend that future work should try to build gamified experiences around the specific goals using befitting game elements that transcend beyond shallow and repetitive game elements (such as the BPL) [22], [122], [132].

Again, in line with the identified factors for the successful integration of game elements to learning systems, it's important to shed light on the role of gamification frameworks in this process. By helping to establish objectives, understand the target learners, invoke the desired gaming influences, identify learner motivations, and gauge perceptions towards gamification, these frameworks serve as a guide for effective design and implementation [11], [168]. [27] framework proposes a six-step process that helps align gamification with system goals, user needs, and ensures continuous engagement. This model's extensive application across business and education environments underscores its comprehensiveness and applicability [26], [91]. The Octalysis framework by [11] is another powerful gamification model that provides a balanced perspective on gamification by addressing both intrinsic and extrinsic motivational factors. The model is nicknamed 'the complete gamification framework.' This comes from Chou's claim that the models' constructs (referred to as the 8 core drives), are back of all human motivated behaviours. Its use across diverse sectors including education [170], [171], healthcare [172], [173], human resource [174] and business [175], [176] demonstrates its versatility and broad appeal [177], [178]. In addition to these, other notable frameworks like Nicholson's RECIPE [32] and Lander's SPIRAL [65] add richness to the strategies for gamification design, enhancing their practical applicability beyond mere extrinsic motivators. However, the choice of a suitable framework should resonate with the specific objectives and context of the gamification project.

Considering these frameworks, we suggest the more thoughtful selection and use of these models in future work to yield more engaging and effective gamified experiences. By doing so, we could move beyond the shallow application of gamification elements and instead foster meaningful, engaging, and effective gamified learning experiences [27], [28], [32].

3. Gamification Equilibrium: The Fulcrum of Balanced Extrinsic and Intrinsic Rewards

As discussed, in this study, extrinsic rewards alone do not create proper gamification, and neither is it possible to design a gamified system with purely intrinsic motivators. In fact, in a gamified system, intrinsic motivation is difficult to achieve, partly because the concept of intrinsic motivation is somewhat individualistic and idiosyncratic [54], [179]–[181], and as expounded by Lieberoth (2014), to attain intrinsic motivation or deep gamification requires the intricate interplay of game dynamics, and it is not merely about the superficial application of game elements. In essence, what we imply by intrinsic motivation being relatively individualistic is that. In intrinsic motivation, an individual gets to define what is intrinsically motivating and what is not, seeing that intrinsic motivation is born [within] from sheer personal interest [42], [83], [182], and of course individuals differ in personality [181], and how they perceive and react to game elements [179], [180]. For example, a study by Denden et al., (2021) on the effects of gender and personality differences on students' perception of game elements in educational gamification found that individual factors significantly influenced the perception of specific game elements. In the study, females found feedback more useful than males, and students low in extraversion found progress bars more useful than those high in extraversion [180]. In a similar vein, a study by Christian E. Lopez and Conrad S. Tucker (2019) also demonstrated the nuanced interplay of individual differences and the perception of gamified systems. Their research revealed that individual variations in cognition, such as spatial ability and working memory, significantly influenced how users experienced and interacted with a gamified educational platform. This underscores that individuals with different cognitive abilities might react differently to the same gamified system, further underscoring the complex and idiosyncratic nature of intrinsic motivation within gamified systems. These then makes the concept of intrinsic rewards an atomistic approach, something that may be challenging to implement in gamification [183]. In learning for instance, rewards (virtual or tangible) can be added as triggers for extrinsic motivation, and that can boost [extrinsic] motivation across multiple individuals regardless of their peculiar innate interest [184], [185]. However, since intrinsic motivation is not dependent on external rewards but on the [appealing nature of the] activity itself and the personal disposition of an individual towards the said activity. It therefore becomes tough to create or trigger intrinsic motivation among individuals who may initially not be interested in an activity that is now gamified [11], [179], [183]. We believe this is one reason gamification struggles in creating intrinsic motivation. In essence, users who aren't intrinsically interested in an activity at first may still not be intrinsically motivated towards that activity even after it is gamified with extrinsic rewards [32], [186]. Now, such users may be extrinsically motivated to engage in the said activity after it is gamified – due to the appeal of amassing external rewards [121], [185]. This goes to say that creating intrinsically motivating gamified systems or solutions is tough. This is because, intrinsic motivators, unlike extrinsic motivators are not reliant on virtual items, goods, or objects (e.g., points and badges) which can be easily deployed on a system or activity [11], [22], [122], [187].

Games are a good example of an intrinsically motivating activity [188]–[190]. Video gamers or gamers generally engage in game play solely for itself – for the fun of it [191]–[193]. Gamification on the other hand, tries to emulate the outcomes of games by harnessing the elements of games and incorporating them into productive activities [192], [194], [195]. Sadly, the results of gamification (in terms of motivating users) differ widely from that of games [196]. This is because, amongst many reasons, games in themselves are intrinsically rewarding [197]–[200]. Whereas gamification in itself isn't even a wholistic entity and cannot be said to be enjoyable by itself. Thus, unlike games, gamification only tries to coalesce (with a system, a process, a product, or an activity) to transform a boring but productive activity into an interesting one. Hence, little to no room is given for intrinsic motivators to find expression, seeing that gamification today (or at least shallow gamification) does not define and design what and how the activity or system should be, as a game does [201]. Gamification, supposedly, only adds to an existing [sometimes rigid] activity or an established system [11], [22], [132], [133]. Again, these additions are usually surficial [202]–[205], primarily in form of extrinsic motivators such as leaderboards, points, or badges [11], [201]. Hence, intrinsic motivation is justifiably absent, seeing that intrinsic motivators aren't reward based per se (virtual or tangible) but are somewhat dependent on intricate interplay of processes, activities, and game dynamics [132], [133]. In ideal but rare cases, intrinsic motivation can be achieved by skilfully designing multiple (sometimes complex) activities, events, and processes on a system as it is with ideal video games [132], [206].

We thus conclude that the two (intrinsic and extrinsic motivators) are needed for an ideal gamified solution. Nevertheless, for effectiveness of gamification on a system, we suggest that the two have to be present in appropriate proportion. Again, appropriate proportion doesn't necessarily mean equal proportion, but balanced measures relative to the context and the needs of system users. As such, we believe again that one requirement for proper gamification on a system is a good balance between extrinsic rewards and intrinsic motivation. This balance should take into account key factors, but most importantly the users of the gamified solution. For instance, when extrinsic rewards dominate learning activities and remain consistently so over a long period of time, studies have shown that it could lead to what is called 'overjustication effect' [207], [208]. On the other hand, intrinsic motivation can never be excessive in gamification, let alone talk of dominating a system. That is, no level of intrinsic motivation can be toxic or detrimental to a system [101], [132], [194], [209]. In fact, the higher the intrinsic motivation level, the greater the outcome [77]. Hence, the challenge primarily comes from extrinsic motivation being ill-regulated. This is because extrinsic rewards to some extent, have been proven to hamper intrinsic motivation, which of course ultimately affects both gamification and learning [34]. Wherefore, we suggest that understanding how to regulate extrinsic rewards relative and proportional to present intrinsic motivation amongst users could be vital key to addressing failed and ineffective gamification, especially in learning. That is, when should extrinsic rewards be increased? At what phase of gamified learning should certain extrinsic motivators be introduced or removed? How can one determine if intrinsic motivation and extrinsic rewards are proportional and vice versa? To address these, we thus propose the gamification equilibrium concept.

3.1 The Concept of First-Class Lever and Equilibrium.

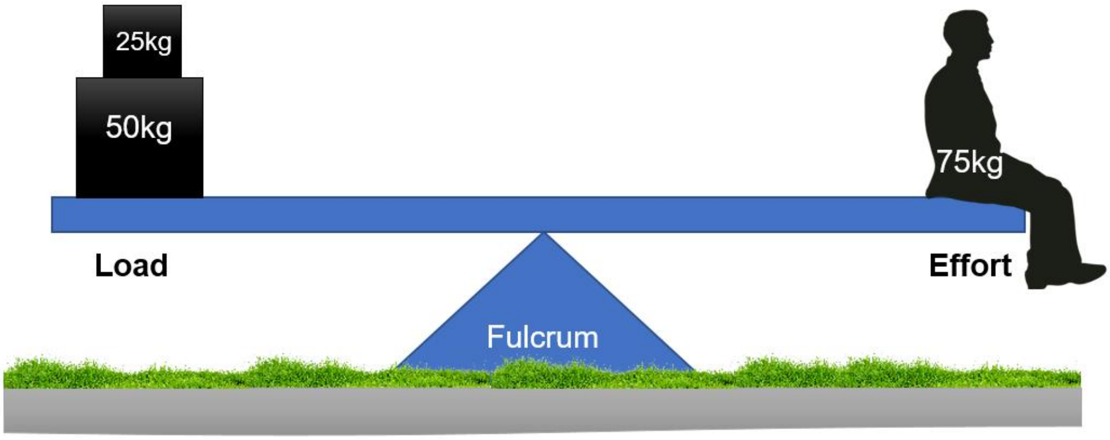

Figure 2. A Balanced See-saw, a typical first class lever machine

As suggested earlier, balancing extrinsic motivators and intrinsic motivation helps improve gamification experience, we develop the concept of gamification equilibrium from the principle and design of a first-class lever to help balance extrinsic motivators (reward) against intrinsic motivation. Levers are simple kind of machines that consists of a beam or rigid rod that is pivoted at a set hinge or fulcrum [210] (Figure *2*). There are three kinds of levers. First class levers, second class levers, and third-class levers. Primarily, levers are used to get work done easily. Some examples of simple machines that utilize the working principles of levers are wheelbarrows, see-saw, scissors, inclined plane, and pulley system. However, the dynamics of a first-class lever as seen in the seesaw (Figure *2*) is what we used in developing our gamification equilibrium concept.

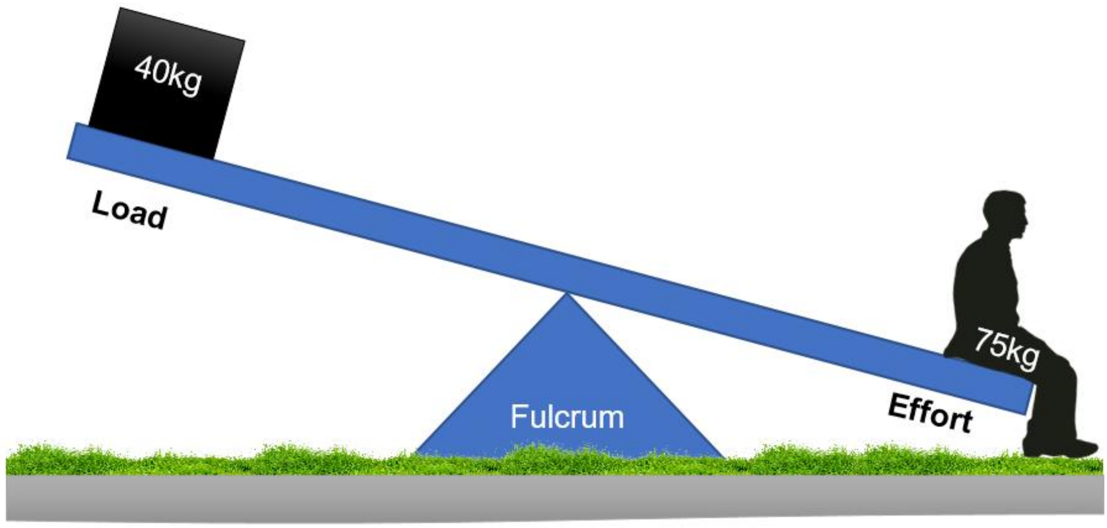

Figure 3. A lopsided See-saw, a typical first-class lever machine.

Now, in the dynamics of a first-class lever as seen in the seesaw (Figure *3*). Provided the fulcrum (pivot) is at the centre of the seesaw plane (equal distance in-between the 'load end' and the 'effort end,') then, when sufficient force (a force greater than the one produced by the 'load end') is applied at the 'effort end' of the lever, it causes it to swings on the fulcrum which makes the 'load end' to be lifted while the 'effort end' swings downward, causing the seesaw to be lopsided (Figure *3*). Similarly, when the force exerted at the 'effort end' is less than the force exerted by the load at the 'load end,' it causes the 'effort end' to swing up. Although, in principle, a first-class lever assumes one end to be the 'load end' and the other to be the 'effort end'. Notwithstanding, in practice, as with the case of a seesaw, load(s) can be placed at both ends with one end theoretically serving as the 'effort end' as seen in Figure *2*. Again, provided the fulcrum is at the centre of the lever (equal distance between the 'load end' and the 'effort end'). Then, when load(s) of equal weight are placed at both ends of a seesaw the lever will remain balance – at a state of equilibrium as in Figure *4*. Now, in situations where the seesaw lever is lopsided due to unequal weights at both ends, equilibrium can still be achieved by either adjusting the position of the fulcrum towards the side of the greater load. Or, by moving the greater load closer to the fulcrum. However, adjusting the fulcrum may only be possible theoretically but not practically. This is because seesaws usually have their fulcrums permanently fixed to the centre of a wooden or metal plane. As such, to create balance, the loads are moved away or towards the fulcrum respectively, as doing this hypothetically changes the position of the fulcrum relative to the start and end points of the two loads on the plane. Thereby, achieving equilibrium.

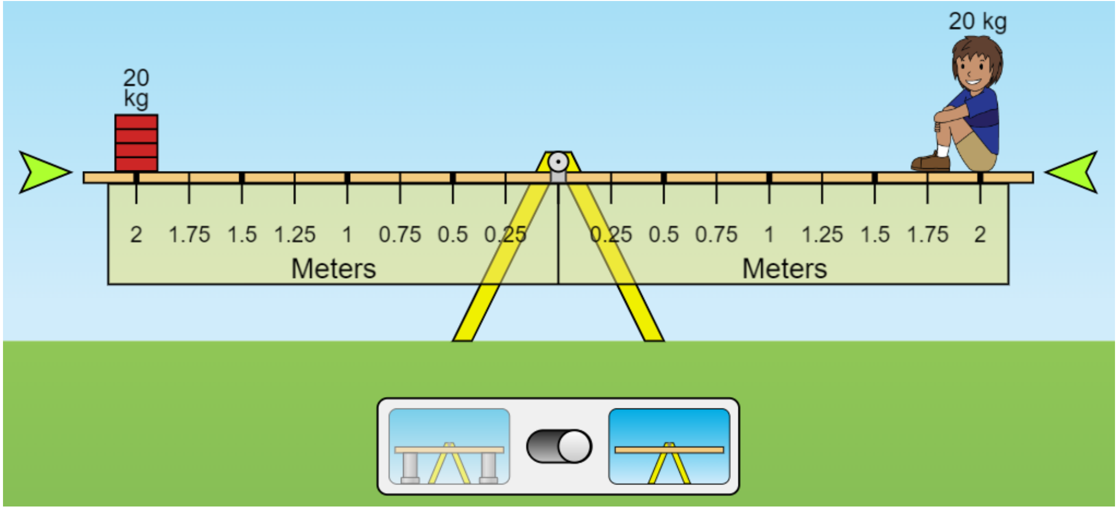

Figure 4. A balanced Seesaw

3.1.1 Mathematical Formula for Achieving Equilibrium.

The entirety of the equilibrium dynamics of a seesaw can be represented in a mathematical formula (known as the law of lever) as shown below [211].

Equilibrium (balance) is achieved when

$$\mathbf{D_1 \times L_1 = D_2 \times L_2}$$

Where;

D = *Distance from fulcrum*

L = *Load (Kg)*

To test and prove the formula in this study we used a [virtual seesaw lab](https://phet.colorado.edu/sims/html/balancing-act/latest/balancing-act_en.html) (https://phet.colorado.edu/sims/html/balancing-act/latest/balancing-act_en.html). Consider the scenario as depicted in Figure 5.

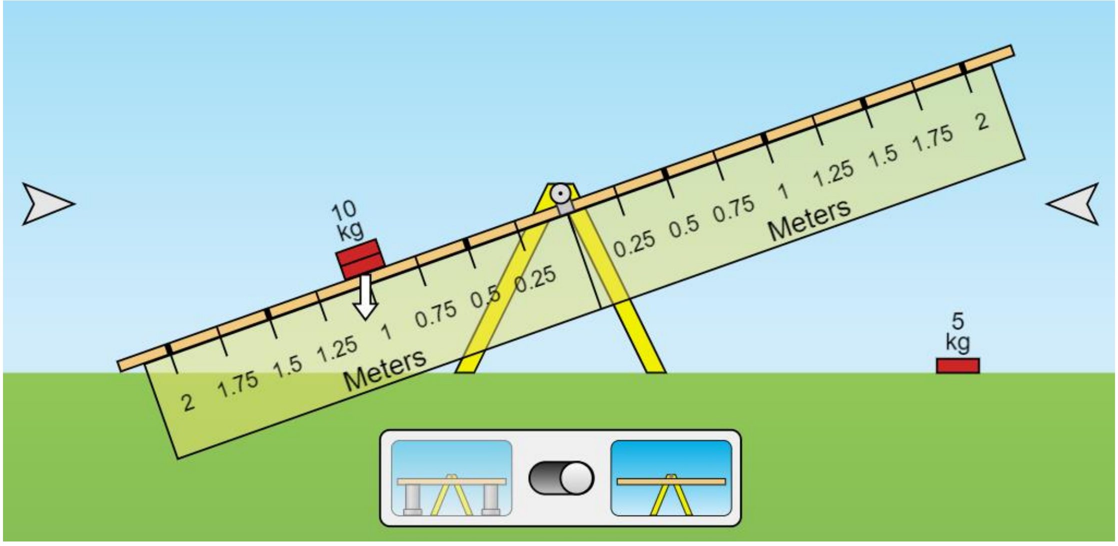

Figure 5. A lopsided seesaw

Assume two loads of 10kg and 5Kg are given. One load of 10Kg is placed 1 metre away from the fulcrum on one side. While the other 5Kg is kept aside. The seesaw becomes lopsided and swings downward on the loaded side. Equilibrium is thus required on the seesaw. Hence, to achieve equilibrium, where should the 5Kg load be placed on the other side (I.e., What distance away from the fulcrum should the 5kg load be placed to achieve balance?)
To answer this, we will apply the equilibrium formula to determine the precise distance of the second load from the fulcrum.

Solution

L1 = 10Kg. D_1 = 1 Metre. D_2 = 5Kg. L_2 = *Unknown*

Since $\mathbf{L_1 \times D_1 = L_2 \times D_2}$

Therefore:

$$10 \times 1 = 5 \times D_2$$

$$\frac{10 \times 1}{5} = D_2$$

$$2 = D_2$$

Hence, to achieve equilibrium, the 5Kg load should be placed 2 metres away from the fulcrum on the other side as shown in Figure *6*.

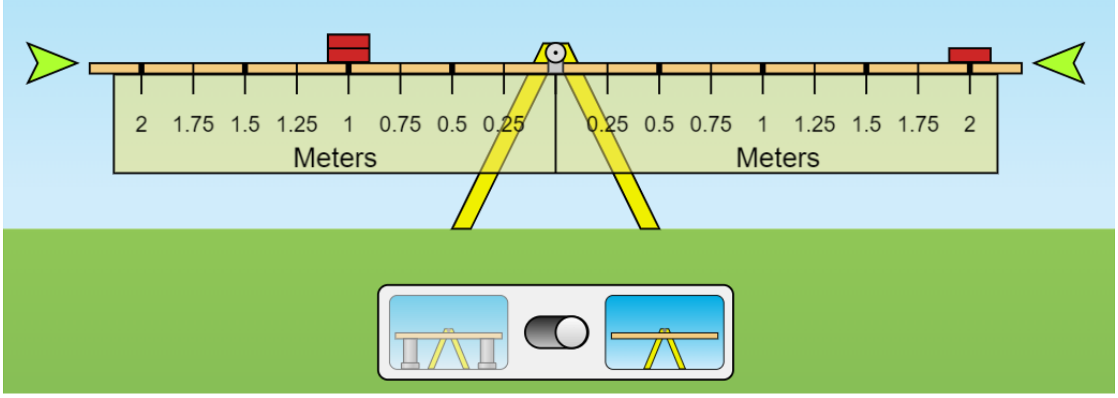

Figure 6. Balanced Weights on a seesaw

As seen in Figure *6*, equilibrium is achieved on a seesaw with unequal weight by simply manipulating the position of the weights away and towards the fulcrum. Hypothetically, it could be said that equilibrium (balance) is achieved by manipulating the fulcrum to and fro relative to the start and end points of the two loads. Now, as with the dynamics of the seesaw (first class lever), we thus treat intrinsic motivation and extrinsic motivator as loads on a ‘gamification lever’. In that, the two must be balanced for effectiveness on a system. Again, as stated earlier, achieving balance between intrinsic motivation and extrinsic rewards does not necessarily mean that the two must be in equal proportion. No. As we have established from the lever principle that loads of unequal weight can still be balanced. Hence, we conceptualize that for an effective gamified learning system the loads, of which in this case are substituted for “intrinsic motivation” and “extrinsic rewards” should be balanced on the lever plane – The learning system.

3.2 Transcribing the Concept into Gamification.

The logical question then is. How can intrinsic motivation and extrinsic rewards be quantified as in the case of actual loads (on a lever) to bring about this equilibrium? While it will be perfect to transcribe and convert the lever equilibrium formula ($\mathbf{L_1 \times D_1 = L_2 \times D_2}$) into something that can be easily applied in gamification development. It may require a lot of careful considerations and several empirical testing which is practically unattainable at a conceptual stage. Nevertheless, in the next section we propose and exemplify some methods with which the equilibrium can be achieved.

At a rudimentary level, one way the equilibrium concept can be actualized on a gamified system is through alternate and sporadic use of game elements on a system and its activities. This means that certain game elements should be active and involved in the activities of a gamified system over a period of time. While other game elements remain dormant and inactive. This alternating and sporadic use of game elements will, we presume, ensure that at each point on the system, intrinsic motivation and extrinsic reward complement and balance each other. In essence, a gamified system should be designed with the consciousness of the level or degree of intrinsic motivation present at each phase of system usage. Then, extrinsic motivators can then be added in appropriate and complementary proportion to equalise and balance the existing intrinsic motivation. Recall that literature has shown that it is profitable for intrinsic motivation to be dominant over extrinsic reward or extrinsic motivation generally in a system (not that extrinsic motivators aren’t important) [47], [53], [212]. However, in scenarios where intrinsic motivation cannot gain dominance over extrinsic rewards, then, it is safer for the two to be at equilibrium. This will help avoid faltering phenomenon such as the overjustification effect, apathy, and demotivation of users in the long run. Thus, in a nutshell, the gamification equilibrium concept (Figure *7*) is an attempt to regulate the impact of overly used extrinsic rewards (such as the BPL) against ‘fragile’ intrinsic motivation in gamification.

3.3 Hypothetical Implementation and Theoretical Success; Practical Keys to Equilibrium

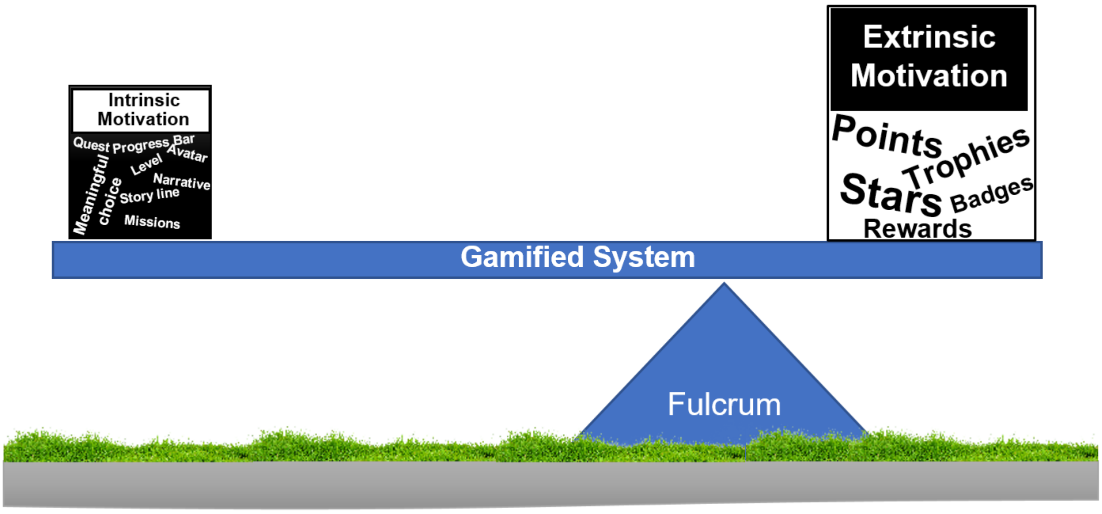

Figure 7. Gamification equilibrium concept

We thus present our equilibrium concept (Figure *7*). We believe the Principle of Equilibrium as we have proposed here is often unconscious in successful gamified systems. In fact, it could theoretically contribute significantly to the success of future gamified systems, if understood. Aside from the sporadic and alternate applications of game elements. Another way we can hypothetically explain how our equilibrium concept (Figure *7*) could be applied and playout is through the economic Law of Diminishing Marginal Utility. The Law of Diminishing Marginal Utility [213], posits that the value or utility a person derives from a good or service reduces with each additional unit consumed. Now, we can say that when this is to be applied to a gamified learning context, this can be seen as the delicate balance between the various game elements and their perceived utility by the learners per time. Consider a scenario where a person is very thirsty and receives a glass of water. At that moment, the water's value is at its peak for this person. However, as they drink more, the utility or value of additional water diminishes. If the water supply is incessant, the person might become disinterested or 'bored' with it. Yet, when this water supply is halted and only resumed when thirst returns, the person is less likely to lose interest in the water. Again, remember that, when an individual shifts attention from the “water drinking,” such individual is surely going to turn to other activities and return later when the thirst returns. The same can be argued for game elements; after achieving a certain level of proficiency or familiarity, a learner's interest in an element may wane. Yet, if we strategically rotate the elements, reintroducing them when they've been missed, we could maintain an optimal level of engagement and learning effectiveness.

To further shed light on this complex interplay of how equilibrium can be practically applied, let's explore a hypothetical scenario of a gamified language learning application. Imagine learners engaging with vocabulary quizzes, grammar drills, and earning points, badges, and stars—extrinsic elements that initially boost motivation. They receive these rewards for accomplishments and proficiency, leading to a surge in intrinsic motivation. However, as the novelty wears off, learners might experience the Law of Diminishing Marginal Utility. The once-exciting extrinsic rewards may lose impact as they become accustomed to them. This situation can be likened to the first-class seesaw lever system we explained (Figure *5*), where equilibrium is disrupted. To prevent this decline in motivation, the hypothetical app's designers would need to introduce intrinsic game elements to rebalance the learning experience. This is where our equilibrium principle comes into play. By incorporating features like meaningful choice and narrative-driven missions, the designers can strike a balance between extrinsic and intrinsic motivators, much like balancing the forces on a lever. For instance, learners might embark on personalized language-learning quests that align with their goals, like focusing on travel-related phrases or business language. These quests can be imbued with exciting storylines, such as solving linguistic puzzles or exploring foreign cultures. By leveraging intrinsic motivation, the app restores balance and resonates with the learners' evolving needs and interests. The intrinsic game elements introduced are not mere supplementary features but essential components that counterbalance the waning allure of extrinsic rewards, thus maintaining equilibrium. The interplay between extrinsic and intrinsic elements forms a dynamic system akin to a well-balanced lever (Figure *7*), continually adapting to sustain learners' engagement.

Based on these premises, it is evident that gamified systems might be employing a form of this equilibrium principle without explicit recognition of its impact. For example, successful video games like Fortnite and Call of Duty regularly introduce new elements while temporarily phasing out old ones to keep player interest high [214] While these examples are not from a learning gamification context, they suggest the potential value of equilibrium in maintaining user engagement.

Furthermore, we speculate that the equilibrium principle could manifest when educators manually try to balance intrinsic and extrinsic motivations within a gamified setting. Suppose a tutor perceives high intrinsic motivation in learners. In that case, they might temporarily withdraw certain extrinsic rewards, akin to reducing the 'supply' of game elements. Once reintroduced, these rewards may be valued anew, as they have been missed, potentially leading to increased engagement and motivation. This is theoretically similar to the Khan Academy's adaptive learning platform strategy of withdrawing and reintroducing rewards to maintain engagement [215] The Khan Academy's adaptive learning platform provides a pertinent example of the possible application of our equilibrium principle in a learning context. It employs a sophisticated system of 'energy points' and 'badges' to maintain learner engagement. These gamification elements are not offered continuously but are carefully presented in a way that ensures learners do not get too accustomed to them, thus preserving their motivational impact. Parallel strategies can be found in the gaming world, especially in games like World of Warcraft, where players earn in-game rewards such as experience points, special items, and character enhancements. These rewards are not continuously distributed but are spaced out to maintain player engagement and the perceived value of these rewards [216]

Outside of learning contexts, we can see the potential application of our equilibrium principle in areas like social media and health and fitness applications. For instance, Instagram and Facebook balance the user's intrinsic motivation to connect and share with the extrinsic motivation provided by new features and varied content such as badges for top fans who are consistent in interacting with a page or group. This approach, including the introduction and withdrawal of features like 'Stories,' can be seen as related to the equilibrium principle [217] Likewise, apps like Fitbit and MyFitnessPal offer badges and other rewards for reaching certain milestones, but they do not provide these continuously. After users reach a goal, the next goal is more challenging, and the rewards are proportionally more substantial. This approach ensures that users don't become desensitized to the rewards, maintaining their motivational value. The balancing act between extrinsic and intrinsic motivators in these apps can be seen as a manifestation of the equilibrium principle, although not explicitly acknowledged [218].

3.3.1 Subtle Application of Equilibrium Concept in Aviation Industry

Again, the concept of equilibrium, a balance between intrinsic motivation and extrinsic rewards, might at first seem abstract (Figure *7*) in the context of gamification. However, this concept can be practically applied and has been successfully implemented in various real-world scenarios, as it reflects the intricate nature of human motivation and the interaction between intrinsic and extrinsic factors. Take the airline industry's dynamic pricing strategy as an illustrative example. Airlines must strike an equilibrium between the desire to maximize revenue and the need to satisfy customers [219], [220]. This balance is not a static point, but a dynamic equilibrium achieved through sophisticated algorithms that adjust ticket prices [221]. They take into consideration a myriad of factors such as timing, demand, and seat availability, all of which fluctuate constantly. Intrinsic motivations such as the appeal of a particular destination or personal affinity for a specific airline are countered by extrinsic motivators like ticket cost, discounts, or loyalty programs. The algorithms must weigh these factors continuously, making minute adjustments to maintain a balance that satisfies both the airline's revenue goals, and the customers' needs and preferences. For example, a flight to a popular destination during peak season may see prices driven up by high demand (an extrinsic factor), while loyalty discounts for frequent fliers might act as an intrinsic motivator, subtly shifting the equilibrium. The airline's pricing strategy demonstrates the practical applicability of the mathematical method presented in this study. It shows how a seemingly simple concept can be translated into a complex and effective real-world solution. This strategy doesn't merely strive for equality between intrinsic and extrinsic factors but rather aims for harmony, in a way that reflects the alternating use of game elements in a gamified system (Figure *7*).

This real-world application not only solidifies the theoretical concept but also fulfills the need for empirical evidence, emphasizing the credibility and applicability of the model in the field of gamification design. Whether in the bustling arena of commercial aviation or the immersive world of gamified experiences, understanding and leveraging the balance between intrinsic motivation and extrinsic rewards can lead to more engaging and successful systems. The airline pricing strategy serves as a concrete example, highlighting how the equilibrium concept is not just theoretical but a practical tool that has been effectively and unconsciously utilized in real-world scenarios.

In summary, while the Principle of Equilibrium's direct implementation in gamified learning systems remains a theoretical conjecture, the unconscious deployment of this principle in other domains suggests its potential value, as we have highlighted by these examples. Future research and experimentation could provide empirical evidence supporting this theoretical framework, improving gamification design strategies, and fostering successful learning outcomes.

4. Results Limitation and Implication for Future Research

In our study, we have put forward the equilibrium principle for the interplay of intrinsic and extrinsic motivation in gamification. However, we acknowledge certain limitations that can serve as opportunities for further exploration.

Primarily, the theoretical nature of our study presents a limitation in practical application. Converting the proposed equilibrium concept into a practical, usable formula in gamification akin to the lever-equilibrium formula ($\mathbf{L_1 \times D_1 = L_2 \times D_2}$) would necessitate a considerable amount of time and rigorous effort. This task requires a comprehensive understanding of gamification dynamics, a deep analysis of the balance between motivational factors, and a meticulous effort to create a mathematical representation that could be universally accepted and applied. The complexity and magnitude of this endeavour are beyond the scope of our current study.

Furthermore, empirical validation of our proposed concept is another significant limitation. While we have drawn upon theoretical underpinnings and provided conceptual arguments to support our proposition, empirical studies are necessary to validate and standardize the constructs and elements involved. This would require carefully designed experiments or observations in real-world gamification settings to measure the effects of maintaining equilibrium between intrinsic and extrinsic motivation.

Despite these limitations, we believe that our work lays the groundwork for an important theoretical construct in the domain of gamification. It presents an open invitation to the scientific community to further examine and refine this concept. We encourage empirical investigations to test its validity, revise the concept as necessary, and explore its potential applications. These efforts could ultimately enhance the effectiveness of gamified systems, promoting better user engagement and learning outcomes.

5. Conclusions

It is no surprise at this point that developing an effective gamified experience isn't cushy. While gamification appears to have a lot of untapped potentials, this study reveals that the phenomenon is still at infancy and requires a lot of work. The study reveals that gamification appeared, primarily, to alter the behaviours of users in various context, but of course not without assistance and leverage from several motivational and IS theories. Of which the endgame of it all is to bring about positive behavioural changes in work, business, learning, and many other spheres of life. Nonetheless, the achievement of the aforementioned have been inconclusive. The study attempted to probe into why gamification has been inconsistent in terms of empirical outcomes. We discovered a couple of factors.

Many gamification studies fail and remain inconclusive because of theoretical misunderstanding that is born out of inordinate replication. The SDT is revealed in this study as the dominant theory used in developing and designing gamified experiences. The SDT postulate that individuals are bound to consciously engage in an activity when they feel in control of it (autonomy), when they feel capable of doing it (competence), and when they feel connected to others by doing it (relatedness). Therefore, researchers have sincerely but wrongly believed that if gamified experiences can be designed with certain elements that can make users feel competent, related, and autonomous then motivation can be achieved. The challenge with this formula is that gamification impacts several contexts differently, and the focus of users differs across contexts. For instance, improving creativity amongst employees may be the goal of gamifying a workplace system, and improving engagement may be the goal of gamifying an e-learning system. Both systems have gamification at their core, but the constituent and game elements of their designs should differ respectively based on their goals and focus. This is because, the backbone theory that is used (as a framework) in a workplace gamification may promote motivation for routine tasks only. However, when that same theoretical build-up is imported and implemented in a learning context, it may still promote motivation amongst learners (as it did in the workplace). However, it could jeopardise other important facets of learning such as creativity among the learners. Why? Because the build-up model was initially tailored to stir up motivation for only routine tasks, which ultimately circumvented creativity whatsoever in non-routine learning activity, and thus made the theory unfit for the learning environment. Wherefore, we call on researchers to address this challenge by expanding the theoretical scope of building and applying gamification. This may not necessarily require creating new models and doing away with existing framework(s). No. Rather, a patching, and a buildout of relevant theories beyond the SDTs to more robust and pinpoint models.

Another issue we discovered to be responsible for the inconsistencies of empirical outcome in gamification is shallow gamification [22], [149], [152]. We define shallow gamification as a weak design and casual addition of unjustified game elements to a system, process, or activity [22]. This largely encompasses the use of extrinsic digital rewards, or excessive use of extrinsic digital rewards (e.g., points, badges, and trophies) on a system or activity by inexperienced or first-hand benefactors [152]. Arbitrarily adding extrinsic reward elements to a system or activity is something anyone can do and name it gamification. A proliferated dimension of this shallow gamification is seen in what is called the "BPL Gamification." This is a cliché where developers and practitioners (usually inexperienced) add "badges," "points," and "leaderboards" to a system (with no proper justification) and call it gamification, and of course technically it qualifies to be called gamification. However, creating an intrinsically enjoyable experience which makes up a proper gamification requires thorough understanding as well as effort that goes beyond adding casual game elements as a catholicon. We thus conclude that in learning, failed or inconclusive findings in gamification can be traced to two major things. One is imbalance between intrinsic motivation and extrinsic motivators (rewards). Another is shallow gamification design by practitioners who are keen to partake of the benefits of gamification with little to no effort on their part.

Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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