

Gamification - Expected and Unexpected Effects

Assist. Prof. Dr. Boris Bankov
University of Economics - Varna, Varna, Bulgaria
boris.bankov@ue-varna.bg

Prof. Dr. Sylvia Parusheva
University of Economics - Varna, Varna, Bulgaria
parusheva@ue-varna.bg

PhD candidate Gergana Kasabova
University of Economics - Varna, Varna, Bulgaria
gkasabova@ue-varna.bg

Abstract

A significant trend in the digitalization age is the mixture of casual activities in professional context. Both practical and scientific research has been conducted in the field of gamification. This methodology describes the ways of applying game design principles in non-gaming environments to motivate, guide, tutor and award participants.

The focus of this study is the expected and unexpected effects of implementing gamification for the developers and the users of IT systems. A meta-analysis on the state of gamification research is presented and a survey among university students is discussed. As a result, parallels are drawn between user behaviors and traditional technical risks of using gamification in software applications.

Keywords: gamification, game design, effects of gamification, gamified software

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Introduction

Gamification, the use of game elements and mechanics in non-game contexts (Deterding, et al. 2011), has gained significant attention and momentum in recent years. Another definition is given by (Chou, 2015) that states gamification is the craft of deriving fun and engaging elements found typically in games and thoughtfully applying them to real-world or productive activities. Although some evidence can be found that gamification has surfaced earlier (in the 80s and 90s), an impressive number of studies have been conducted in the last decade. Extensive research done by scholars and practitioners exploring its effects, benefits, and challenges is regularly being reevaluated as our digital society continues to morph and evolve. Gamification as a continuous process of enhancing and improving the business processes and information systems of the companies in terms of participation, motivation and engagement as described by (Stoyanova, 2015).

Game design is the process of creating the content and rules of a game as explained in (Brathwaite, 2009). The goal is to supplement existing software with a subsystem that either supercharges its functionality or stimulates changes in human behavior.

Game design elements are the building components of the game (Zichermann et al. 2011). They are used to make tasks more engaging and enjoyable by incorporating points, badges, leaderboards, tasks, virtual currencies, and other game-like features. Effective application of gamification requires understanding of human behavioral psychology as well as software limitations.

Game elements can be summarized as follows:

- **Tasks** – their main goal is to drive user behavior in a specific way: to get familiar with software, to cooperate with others, to improve their skills, health or knowledge.

- **Rewards** – they are used to encourage participants and appear in varying forms.

Tasks often include challenges with specific constraints and both clear and hidden rules. They can increase in difficulty or have time limitations. The latter is used as a psychological tool to create discipline in participants. Some tasks for example can ‘refresh’ on a daily basis encouraging users to log-in or check their status in an app or a website.

Rewards vary in their presentation and function and can be part of a complex system to obfuscate the cost of user efforts in attaining goals in the gamified software. Rewards can be divided into two groups based on their function: **progression-based** and **prestige-based**.

Progression-based rewards include experience points, currencies, and abilities. Abilities can give access to harder tasks, skip time limitations, convert currencies, etc. Experience points usually help users understand their progress towards a higher status on the platform. Currencies enable users to collect and purchase cosmetics which in turn increase their prestige. Cosmetics are often avatars, profile backgrounds, badges (trophies, medals). Prestige can be illustrated by ranking on leaderboards, collection level and having rare cosmetics displayed on their profile. The typical representation of the game engagement loop is shown on Figure 1. Users of gamified systems need to be able to discern the clear goals set for them and how they can achieve those goals. Visual indicators such as progress bars, checklists and difficulty ratings entice consumers to perform small actions such as sharing milestones on Facebook or X, formerly known as Twitter.

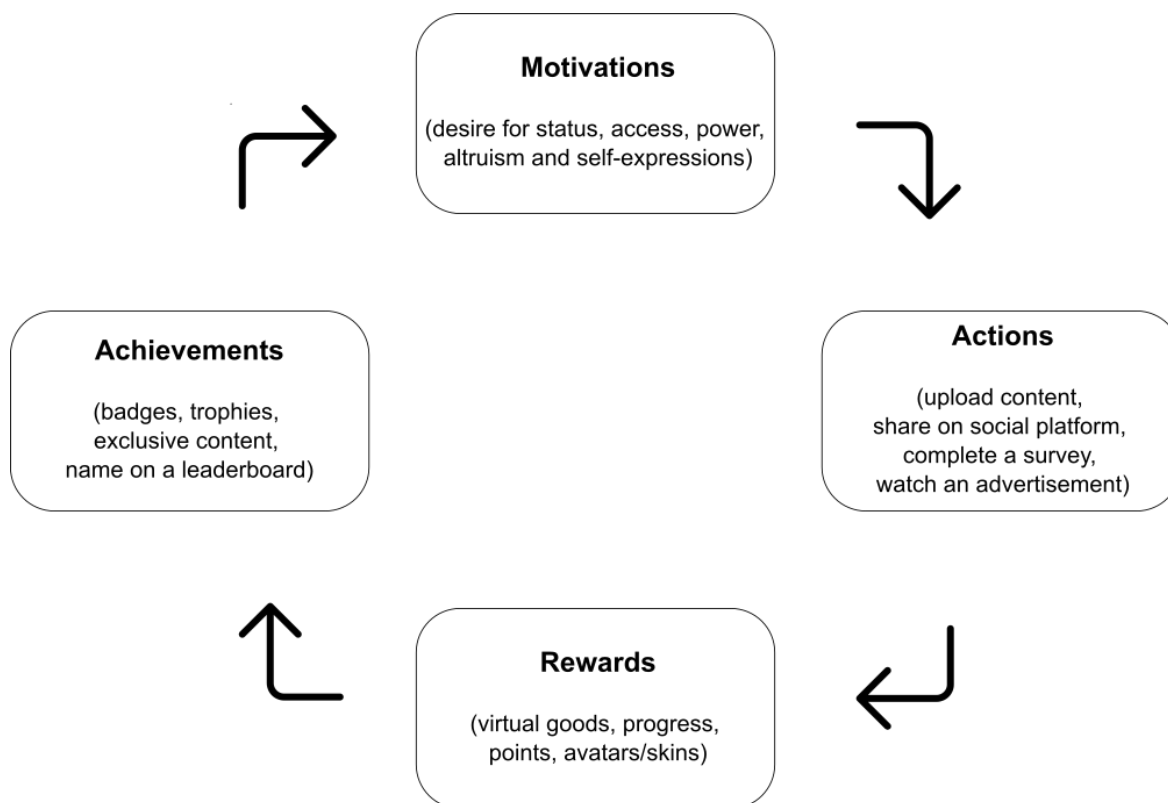


Figure 1. Game Engagement Loop

Research in this field has outlined a number of positive and negative effects. On one hand is the motivational, competitive, and disciplinary aspect. Researchers have delved into the psychological mechanisms that drive individuals to engage with gamified systems. Gamification can be successful in different contexts, but it has its drawbacks both for users and software engineers. By understanding the risks, more effective strategies can be discovered and implemented.

Numerous studies have explored how gamification can enhance learning, boost productivity, and encourage healthy behaviors. For example, in education, gamified e-learning platforms have shown promise in increasing student engagement and knowledge retention. In the workplace, gamification has been used to improve employee performance, foster teamwork, and increase job satisfaction. Research, however, has also shown that cheating and harassment can be found in cases where leaderboards and prestige from completing milestones are not properly set up. These ethical questions may always persist. Researchers have examined situations related to data privacy, addiction, and the potential for gamification to manipulate user behavior. Striking a balance between encouraging positive engagement and avoiding unethical manipulation is a key concern.

Gamified systems often relate to online education. Undoubtedly, even at a young age, infants begin learning how to use their motor skills, make facial expressions, learn to eat on their own by engaging in games with their parents. It is a natural reaction to be more interested in fun activities and games build a dynamic between effort and reward, that eventually grows into habits.

Gamification has been used in business as a means to incentivize teams to reach goals, to stimulate collective spirit, and to improve new software integrations. Healthcare has seen the emergence of "health gamification," where apps and devices use game elements to promote healthy habits and monitor patient progress. In environmental conservation, gamification has been utilized to engage the public in sustainability efforts.

1. Literature overview

An early systematic review of existing research is provided by (Johnson et al. 2016) from the prism of gamification in healthcare software. Their research identifies 365 papers (not limited to healthcare only) out of which 221 were duplicates, 30 remained after title and abstract filtering and finally 19 were considered and assessed as full texts. The final batch consists of 19 papers. The majority of studies explore mobile devices or websites as the delivery platform. The impact of gamified interventions on health is predominantly positive (59%), with some studies report mixed or neutral effects (41%). No negative effects on the physical wellbeing but there is evidence of less than desirable user experience. Rewards, leaderboards, and avatars are the most notable types of game elements in the analysis. Test groups are from different ages and the study shows that gamification can have positive effects across children, adolescents, and young adults. Notably, none of the studies investigated the effects of game design elements on intrinsic motivation. Gamification also shows positive effects in the context of nutrition, healthcare utilization, medication adherence, and blood glucose monitoring. However, the quality and quantity of evidence remain limited, and the impact of specific game design elements and motivational theories needs further exploration.

Larger meta-analysis is presented by (Kim et al. 2021). The study initially marks 253 potential documents on gamification effects but by eliminating duplicates, and full text screening only 18 are eligible for a systematic review. In this study, participants are divided into three age groups: K-12 students, college students, and adult non-students. The study aims to examine the effects of gamified interventions on these groups, particularly focusing on the effect size (ES) of these interventions. The results reveal significant differences in ES between the three age groups. Interestingly, the gamified intervention is found to have the most significant impact on older adults, surpassing its effects on K-12 and college students. The study also observed that **adults exhibited greater engagement with gamified interventions**. This phenomenon might be attributed to the influence of social modeling on older users, where mechanisms like leaderboards played a significant role. In contrast, younger generations may be less influenced by these gamified elements, possibly because they have been exposed to such strategies from a young age. These findings challenge previous research that suggested younger individuals place a higher value on technology's usefulness.

Furthermore, the study indicates that the length of gamified interventions matters. Short-term gamified interventions lasting days are found to be significantly more effective than those

lasting 1-2 years. This preference for short-term rewards aligns with the concept of hyperbolic discounting, which implies that learners may have more motivation for intensive, short-term scenarios. To optimize gamified interventions, it is recommended that educators **carefully plan and consider timing and duration**, taking into account learners' needs and motivations.

Regarding the impact on learning outcomes, the study revealed that gamification has a more substantial effect on a learner's participation level compared to test scores. This suggests that educators can use gamification strategies to improve participation levels, ultimately influencing learning outcomes positively.

In conclusion, the study found that gamification has a moderate and positive impact on learners' behavioral change in gamified educational interventions. Newer generations compared to older adults seem less excited about gamification as they are used to a more informal approach in the classroom.

A more recent meta-analysis is done by (Almeida et al. 2023) where the focus is linking negative effects of gamification to specific game elements by evaluating previous research in the field. To complement the study, they reach out to developers of gamified software and present the issues encountered during and after the development process. Using different search methods (Scopus and Google Scholar search, and backward and forward snowballing in references), the authors retrieved more than 3458 papers which after different filtering and reviewing actions got reduced to 87 papers that mention any negative effects from gamification.

According to their selection process at least two or more papers mentioned a negative effect tied to specific game elements. Badges and leaderboards are the top offenders as they were present in 26 of the papers. The negative effects themselves are lack of effect, worsened performance, demotivation, lack of understanding and more. It can be argued that some of the observations can be attributed to forces outside of the gamified software. Others seem to be duplicates (anxiety and stress, lack of time to participate and time pressure). Effects that are linked to personal preferences such as dislike of competition can be discussed in the broader scope of having to participate in activities that are not desirable in any context.

The study maps which game elements cause specific negative effects (See Table 1) in the analyzed documents. We decided to omit some types of game elements as they can be seen as derivative of others as well as negative effects that are mentioned only once (e.g. Anxiety and Lower Playfulness) or Extra Human effort which can be argued is present always in any add-on to a system.

Table 1. Occurrences of negative effect by specific game element

№	Achievements	Badges	Challenges/	Leaderboards	Points	Rewards
Demotivation	-	-	-	3	-	-
Discouragement	-	-	-	2	-	-
Dislike of Gamification	-	-	2	2	-	-
Gaming the System	-	-	-	3	-	-
Irrelevance	2	5	-	-	-	-
Lack of Effect	-	6	-	-	6	-
Lack of Improvement	-	2	-	2	-	-
Lack of Motivation	-	2	-	2	-	2
Lack of Understanding	-	2	2	3	-	-

№	Achievements	Badges	Challenges/	Leaderboards	Points	Rewards
Loss of Intrinsic Motivation	-	2	-	-	-	-
Lower Playfulness	-	-	-	2	-	-
Time Pressure	-	3	-	-	2	-
Worsened Performance	5	5	4	6	3	-

The data shows that there is some correlation between the number of uses of specified game elements and the number of times a negative effect is being reported, e.g. Badges and Leaderboards. Based on the reported feedback, Almeida et al. writes that developers are mostly unaware of the caused issues by gamified software.

2. Developing gamified software

Developers of gamified software, like any other software developers, face a range of risks and challenges. These risks can impact the success of their gamified projects and can be difficult to overcome if not accounted for early in the lifecycle of a tech solution. Obviously, the lack of engagement can cause a lot of overhead and be heavy on the system architecture. Any existing application requires additional visual implementations, business logic and data storage to track all game element interactions.

Another problem that arises and as seen in the documented cases is bad user experience. Poorly implemented gamification can lead to different problems, such as confusing interfaces, slow loading times, or technical glitches. Improper use of gamification can be a potential risk for user`s privacy as additional software functionality can provide unforeseen ways for data breach. Gamified components usually track user activity on top of regular software operations. The collection process can present vulnerabilities for the system and the user`s data.

Another risk lies in overgamification. Implementing too many game elements and forcing the users to interact with them can result in demotivation. Reiterating the software`s gamified components to try and increase engagement poses security and stability dangers. This in turn can prove more costly from a financial standpoint than anticipated.

While user engagement is a goal, developers need to be mindful not to create software that leads to user addiction or unhealthy behavior, especially in cases related to gambling or excessive screen time. Developers need to ensure that the content, rewards, and challenges in gamified software are appropriate for the target audience. Inappropriate content can lead to negative consequences or public backlash. Developers should consider the ethical implications of gamification, such as encouraging certain behaviors or using psychological tactics to engage users. Ethical considerations are crucial for long-term success.

Gamified software should have clear objectives and a well-defined strategy. Without a clear sense of purpose, the gamification may not align with the overall goals of the software. Gamified software requires ongoing maintenance and updates to keep it relevant and effective. Neglecting updates can lead to user dissatisfaction and decreased engagement. Developers need to ensure that gamified software is accessible to all users, including those with disabilities. Failing to do so can result in exclusion and legal issues. Accessibility does not always pertain to people with special needs. It is also used to improve user experience in general, when ICT is used by the elderly, when the environment is causing difficulties for the user, e.g., bright sunlight or low connectivity. There are a number of laws and standards for creating accessible software applications and they need to be considered for gamified systems.

Additionally, it is important to account for possible feedback support needs. Handling user input on gamification must also be screened and considered carefully. Pushing updates in computer

games can be a different experience for developers as changes to existing game logic can result in lowered expectations and lack of faith in the systems.

To mitigate these risks, developers should conduct thorough planning and testing, consider the ethical implications of their gamification strategies, actively seek user feedback, and stay informed about relevant laws and regulations. Additionally, developers should regularly monitor the software's performance and make adjustments as needed to ensure its success and effectiveness.

Both (Almeida et al. 2023) and (Toda et al. 2018) point out that the most widely mentioned field of application for gamification in their respective meta-analysis is the field of computer science and computer science education. As a part of a government-funded project on a national level NIR – 71/2023 we are interested in the transformation towards an intelligent education using interactive and gamified methods in the University of Economics – Varna. Currently in our university for the purpose of digital education we rely on an online e-learning platform based on the open-source software Moodle. The goal of the project is to study and propose possible improvements to the existing platform using modern approaches in higher education. Some researchers (Nacheva, 2022), (Todoranova et al. 2021) have offered insight into utilizing different tools and methodologies to evaluate the opportunities of enhancing the education process.

To complement our study, we conducted a survey among 84 students in the field of computer science at the university. The survey contained 6 questions and the results are as follows:

- 1) When did you last play a computer/console/mobile video game?
 - a. In the last 24 hours (54.8%)
 - b. In the last week (16.7%)
 - c. This month (9.5%)
 - d. This year (2.4%)
 - e. Last year or further back (16.7%)
 - f. Never (0%)

- 2) What is/was the main reason to play (can choose more than 2)?
 - a. Entertainment (95.2%)
 - b. Social activity with friends (40.5%)
 - c. I saw a promotion and I liked the game (0%)
 - d. Training for a competition (0%)
 - e. Earn a prize/money (2.4%)
 - f. To create videos/content to publish online (0%)
 - g. Developing or desire to develop a game (professionally) (9.5%)

- 3) Which of the following game elements matter to you (can choose more than one)?
 - a. Virtual currency (33.3%)
 - b. Achievements (66.7%)
 - c. Skins/Avatars (52.4%)
 - d. Leaderboards (40.5%)
 - e. Profile upgrades (31%)
 - f. Difficult/hard missions with prestigious rewards (57.1%)
 - g. Time-limited features (38.1%)

- 4) Do you think a software platform for education can be improved by inclusion of game elements?
 - a. Yes (47.6%)
 - b. It is likely (42.9%)
 - c. Not sure (7.1%)
 - d. It is not likely (2.4%)
 - e. No (0%)

- 5) Which game elements can be used to create discipline and motivation to increase engagement in a platform like Moodle?
- a. Virtual currency (31%)
 - b. Achievements (76.2%)
 - c. Skins/Avatars (40.5%)
 - d. Leaderboards (38.1%)
 - e. Profile upgrades (38.1%)
 - f. Difficult/hard missions with prestigious rewards (54.8%)
 - g. Time-limited features (28.6%)
- 6) In the field of computer science education, do you think it is possible to create a software that is first thought out as a game and then enhanced by a e-learning subsystem?
- a. Yes (45.2%)
 - b. It is likely (40.5%)
 - c. Not sure (7.1%)
 - d. It is not likely (4.8%)
 - e. No (2.4%)

Currently the Moodle platform has a few “games” that are used as quiz templates. They include Hangman, Who wants to be a millionaire and crossword puzzle. Students are not widely familiar with their scope, but their novelty has given us a chance to stimulate engagement during lectures. However, their simplicity and lack of deeper integration with the platform pose a limit to how far we can increase the interactive side of the e-learning system. We asked these questions to align existing research and the current state of engagement with video games. The results can be used as a steppingstone for further research. Currently a large portion of the student body actively participates in games (more than 70% have played games in the past week), the majority enjoy gaming (95%) and partake in activities with their friends. It is interesting to point out that achievements are highly appreciated (66%) as they combine goals with rewards. More than half of the respondents understand that difficult tasks are more lucrative (57%) as well as seeing their potential in enhancing education-oriented software like Moodle. The last question pertains to already existing software like CodinGame, CodeCombat, SQL Murder Mystery, While True: Learn. The majority of students have experienced similar software and find it helpful in the introductory steps of programming. These examples cannot be evaluated in the same way as gamified software as the positive and negative effects are quite different. But by narrowing the gap between these tech solutions we definitely can improve the way our students approach the task and reward dynamic.

Conclusion

In contemporary science contexts, the incorporation of gamification into software platforms has garnered significant attention and research interest due to its profound implications for enhancing the user experience. The multifaceted reasons for the importance of gamification in business, healthcare and education are grounded in both empirical evidence and theoretical underpinnings.

First and foremost, gamification serves as a potent tool for increasing engagement and motivation. Extensive studies have shown that when educational content is gamified, it aligns more closely with the intrinsic motivations of learners, such as the desire for mastery, autonomy, and relatedness. By integrating game elements such as rewards, challenges, and progression, students are incentivized to actively participate in the learning process, leading to higher levels of commitment and persistence.

Furthermore, gamification offers a versatile means of catering to diverse learning styles and preferences. Participants can choose their paths, set their pace, and engage with content in a manner that suits their individual learning preferences. The significance of gamification is accentuated by its potential to promote skill acquisition and knowledge retention. Understanding the potential

positive and negative effects of gamification can help both developers and users optimize tech risks and goals.

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