A Systematic Review of Gamified Systems: A New Model for Strategic Development in Future Gamification Research

Elnaz Nasirzadeh*

*Corresponding Author, Assistant Prof., Department of Information Technology Management, Faculty of Industrial and Technology Management, College of Management, University of Tehran, Tehran, Iran. E-mail: nasirzadeh@ut.ac.ir

Abstract

Today, gamification is being used in various areas such as education, health, and business to enhance engagement and increase the system's efficiency. Despite significant scholarly interest, in many cases, undesirable results have been achieved using gamified solutions. This highlights the need for further research to explore these challenges through innovative methodologies and to devise new solutions. Addressing this gap, we conducted a systematic review of the literature on the emerging and growing subject of gamification using the PRISMA methodology and proposed a novel model for the strategic development of future gamification studies. The research led to the identification of 48 qualified empirical studies which have been analyzed to outline the existing views, gaps, and consequently the implications for future research. Through the analysis, we delineate the impact and effectiveness of gamification, highlighting its potential to transform user experience positively when implemented with strategic finesse. Consequently, we propose a novel model for the strategic development of future gamification studies, presenting it in three main dimensions: Contexts, Users, and Elements, and for each dimension, significant and less-paid topics are discussed. In addition, we represent six main suggestions for the design of the entire gamified system: Decision-Making Methods, Success Factors, Validation Methods, Dynamic Design Approach, Timeframe, and Modern Technology. Our proposed model not only facilitates a deeper understanding of gamified systems but also offers actionable insights and guidelines for both academics and practitioners. It is meticulously designed to assist researchers and practitioners in crafting more effective gamified systems that are customized to meet specific user needs and environmental contexts. By doing so, it aims to maximize the sustainable benefits of gamification, ensuring that these systems deliver significant and lasting impacts. This strategic approach integrates the latest advancements in technology and dynamic design principles, establishing a robust framework for the future of gamification research and application.

Keywords: Gamification, Systematic review, Game elements, Games, Gamified system.

Introduction

Games have played an important role in the growth and evolution of human beings, and their ability to attract the attention of people and stimulate their sense of participation is undeniable (Zeybek & Saygı, 2024). With the advancement of the game industry, several game-inspired designs such as serious games (Baptista & Oliveira, 2018), simulation games (Johnson et al., 2017), and game-based learning (Kapp, 2012) have emerged, which have made tremendous changes in improving social functions such as education, health, and business. An important point about the aforementioned concepts is that they are often essentially full-fledged games and are often used separately from, rather than as part of, real-world systems (Codish & Ravid, 2022).

Recently, with the advent of technological advances, the interdisciplinary field of gamification has emerged. This field incorporates the integration of game design elements, thereby introducing a game layer to the original system, which operates within a non-game context, and aims to present solutions for organizational and individual problems (Werbach & Hunter, 2022).

Gamification was first introduced by Nick Pelling in 2002 and attracted academic attention after 8 years in 2010 (Albrecht et al., 2023). As a newfound phenomenon, there are different definitions of gamification, each focusing on certain aspects of the concept. Kapp (2012) described gamification as a concept that involves "using game-based mechanics, aesthetics, and game thinking to engage people, motivate action, promote learning, and solve problems." Gamification is the utilization of game elements to advance engagement and enjoyment of problem-solving in non-game contexts (Kapp, 2012; Werbach & Hunter, 2022), and it has been used generally in industry and academia as a tool for user motivation and behavior improvement. An increasing number of firms have now applied gamified systems for reorganizing the processes, in which resources are invested (Hanus & Fox, 2018). According to Hamari et al. (2018), gamification is defined as "a process of enhancing a service with affordances for gameful experiences to support user's overall value creation." Generally, the popular definition most cited by researchers refers to Deterding et al. (2011), in which gamification is defined as: "The use of game elements in non-game contexts to improve user experience and user engagement."

To motivate users properly, gamification requires a great deal of effort to design and implement gamified solutions (Badihi & Heydarnoori, 2017). It is recommended that the assessment of the effectiveness of gamification should be considered as a pertinent practical issue (Hamari et al., 2018), and there is a need for empirical studies to be conducted to evaluate the effectiveness of gamification.

Many studies have been done to take advantage of the motivational benefits of gamification (Zeybek & Saygı, 2024), and they cover various topics such as health, education, and commerce (Auvinen et al., 2019; Hamari et al., 2018; Zeybek & Saygı, 2024). The studies have shown that gamification applications can be challenging and the core objectives in gamified systems, primarily engagement of individuals, may not be achieved as expected, and negative outcomes may emerge as well (Hamari et al., 2018). There is a limit to what can be done by gamification, and it is not always a one-size-fits-all solution (Jia et al., 2016). It is suggested that gamification is a tool that increases engagement only if it is implemented properly and that it may not be used as a generic solution for every situation (Robson et al., 2016). The predictions indicate that some gamified systems may be unsuccessful due to the lack of game design talent needed (Zeybek & Saygı, 2024) and the lack of understanding of how to design and implement gamification (Morschheuser & Hamari, 2019). Besides, despite extensive research in this area, there is no clear theoretical guidance for gamification yet (Koivisto & Hamari, 2019), and there are many ambiguities in this area. Therefore, to target and guide the activities of gamification and the communication between fragmented pieces developed by various researchers from various perspectives (Koivisto & Hamari, 2019), as well as because of the absence of a reasonable comprehension of the efficacy of gamified systems, there is a need for systematic comprehensive reviews on the studies in the field of gamification to provide a comprehensive summary of the findings and the literature gaps so that researchers can direct their future research around gamification.

This paper contributes to a better understanding of gamified systems by providing a multidisciplinary review of the empirical research on the rapidly emerging academic literature on gamification. A systematic review in this field seems a timely attempt to present a collective understanding of gamification and also identify the existing findings. Finally, based on the presented review, we provide a new model for the strategic development of future gamification studies so that designers will be able to adopt more complete strategies.

Compared to earlier systematic reviews on gamification, our contribution presents a novel model, that addresses less-focused areas in gamification; focusing on the dimensions presented in this model, researchers can achieve further findings, which can be used to increase the engagement and enjoyment of individuals who are the main goal of the gamified systems. To the best of our knowledge, there is no systematic review of gamification from this point of view in the relevant literature.

This paper is structured as follows: In the next section, we describe the methodology applied to the research process. In the third section, we present the results followed by a tabulated list of the final set of studies, which are then analyzed. In Section 4, we present a model containing guidelines for the development of future gamification research, in which the main findings and challenges for future research have been discussed. Finally, the conclusions of our study are presented in the last section.

Literature Review

Gamification is one of the most engaging and widely used methods that has been employed in recent years in the field of designing systems and applications. One of the main advantages of gamification is the increase in motivation, interaction, and participation of individuals, and its core idea stems from the innate desire of humans to play, solve problems, and entertain. For example, students in the class are often tired and bored, but if the instructor suggests playing a game together instead of listening to the lesson, they will be motivated quickly and a significant portion of their tiredness will disappear (Codish & Ravid, 2022). Therefore, by utilizing gamification, routine and tedious activities of life can be presented to individuals in the form of engaging and entertaining challenges and issues, and engage them. Among the applications of gamification, it can be mentioned to encourage individuals to solve problems, perform the desired action more effectively, involve more people with situations and activities, and improve self-confidence to improve the learning process (Koivisto & Hamari, 2019).

Over the past few years, gamification has become increasingly popular across various fields such as education (Codish & Ravid, 2022; Ibáñez et al., 2021; Jones et al., 2023), health and medical issues (Chung et al., 2018; Marques et al., 2019), media (Rosani et al., 2020; Vets et al., 2020; Wang et al., 2021), social issues (Albrecht et al., 2023; Mavletova, 2022), and tourism (Adukaite et al., 2017). It is evident that with the increasing progress in the field of gamification, the need for more extensive and comprehensive studies and efforts in this area is apparent (Koivisto & Hamari, 2019). This field presents a significant opportunity for researchers to advance further and improve by delving deeper into the influential factors of gamification implementation, providing methods for improvement and innovation in game and other program designs, as well as examining the effects of these techniques on individuals' behavior and performance (Jones et al., 2023). Researchers should focus on new methods of evaluating the effects of gamification on audiences, and innovative approaches to designing and implementing gamification systems in various environments.

In the field of education, there is a need for further research to investigate optimal methods of using gamification to increase student participation and commitment, as well as to enhance the learning process (Ibáñez et al., 2021). Furthermore, in organizational contexts, investigating the performance of gamification systems in enhancing motivation, engagement,

and employee performance is of paramount importance (Sakamoto et al., 2016). Additionally, examining the social and psychological effects of gamification, including its impact on individual and societal behaviors, requires extensive research (Prandi et al., 2022). Studying the positive and negative effects of gamification on social relationships, individual motivations, and even mental health can contribute to a better understanding of this phenomenon and the provision of appropriate strategies for optimal utilization across various domains (Mavletova, 2022).

Therefore, researchers in the field of gamification must focus on different topics and utilize diverse research methods to improve understanding of this technology and enhance its applications in everyday life and various industries. However, gamification is not without challenges, and potential obstacles and problems should also be considered when utilizing and implementing it. Hence, while gamification is recognized as a powerful tool for increasing user engagement and participation, recognizing and managing its challenges are also critical. This requires paying attention to details, careful analysis, and using appropriate solutions to prevent or solve these challenges. By addressing these issues, gamification can be used as an effective and efficient tool in achieving various goals such as increasing participation, promoting education, and boosting motivation (Wang, 2017).

Utilizing game elements in non-gaming contexts is not a straightforward endeavor and requires a particular skill to embed gaming mechanisms in environments that are not originally designed for gameplay (Koivisto & Hamari, 2019). This research aims to investigate the challenges associated with gamification and propose a model to address them, thereby enabling more effective utilization of gamification to achieve various objectives in diverse fields such as education, marketing, healthcare, and beyond. To this end, the study delves into defining the challenges and future opportunities in gamification, seeking to provide novel and innovative solutions for the optimal utilization of this approach.

Methodology

This study followed the PRISMA approach for conducting the systematic review. The method was applied as a review protocol, which provides a detailed guideline of the preferred reporting style for systematic reviews and meta-analyses (Moher et al., 2010). Initially, all available studies in the field of gamification were considered, where gamification is defined as the use of game elements in non-game contexts (Deterding et al., 2011). Key aspects of the method are explained as follows.

Eligibility criteria

An initial search revealed a large number of studies and reports on the topic, which were then filtered using inclusion and exclusion criteria adopted from the works by Zeybek and Saygı (2024) and Johnson et al. (2017). The following criteria were then considered:

Inclusion criteria

- Full-papers
- Explicitly stated and described gamification as a research subject
- Explicitly stated and described gamification elements
- Empirical research (qualitative, quantitative, or mixed method)
- Explained research methodology or analysis
- Clearly described outcomes related to gamification

Exclusion criteria

- Gamification was mentioned but not as a part of the research being conducted
- Short papers reporting on research in progress
- Extended abstracts and posters
- Descriptive papers without empirical data
- Publications written in a language other than English

Information sources

In this research, a systematic review of the literature was conducted on the field of gamification studies, indexed in related databases such as Scopus, Web of Science (WOS), EBSCOHost, ProQuest, Google Scholar, ACM Digital Library, Science Direct, IEEE Xplore, and Springer. Additionally, following Koivisto and Hamari (2019), we included articles, articles in press, conference papers, and books to exclude non-academic publications. This approach ensured that most of the academic literature in the field of gamification was accessed. Furthermore, we conducted a manual search of reference lists of key studies, which led to the identification of some additional studies. The searches for this review were conducted in August 2023; a combination of search terms, gamif* OR "game elements" OR "game mechanics" OR "game dynamics," was used and examined in titles, abstracts, and keywords.

In the aforementioned databases, the selection of sources followed the process suggested in the PRISMA method, as shown in Figure 1.
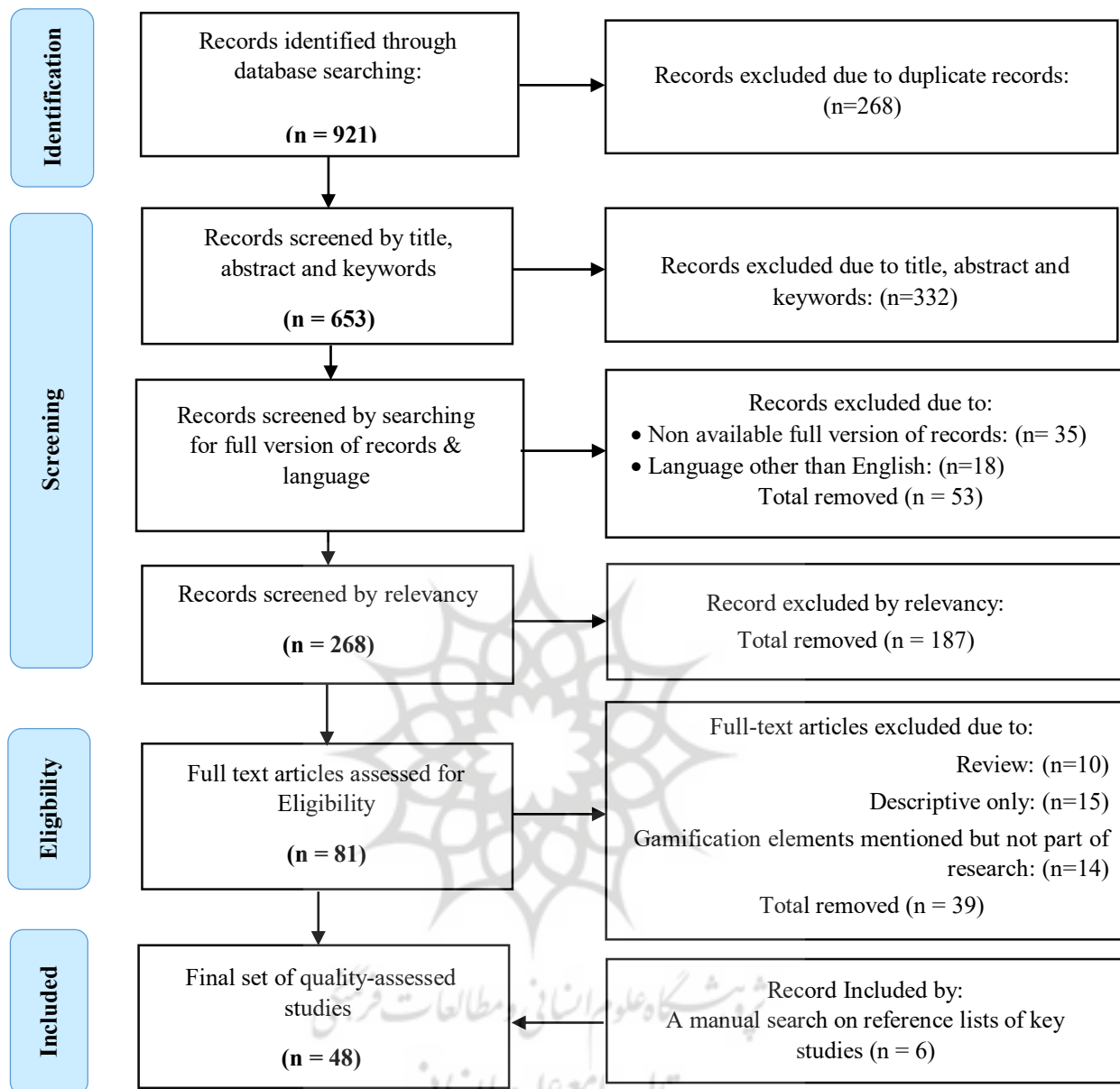
Figure 1. Flow diagram of the search strategy

Results

A total of 48 studies progressed to the final stage as primary gamification studies for examination in this research. These studies are listed in Appendix A, and their corresponding information was analyzed considering data items to include: scope of gamification and the definition used, reference information (authors' names and publication year), aim(s) of the study, user context or sample size (sampling data, e.g., age and gender of participants), gamification elements applied, technology context or modalities applied in developing the gamified systems, results, and implications and future research suggested by researchers.

In this section, further explanations about user context, technology context, and gamification elements are provided. However, other items including the aims of the study, results, and future research were used for the model presented in the discussion section.

Studies' user context or sample size

The sample sizes of studied research ranged from 6 to 10254, and the average was 477. Most of the participants were reported to be students; in 19 cases the participants were university/college students, in three studies, students of primary schools were the subject, and in one research, students of middle school were selected as participants. Most papers lacked sufficient information about participants and their inclusion criteria, and no particular special method has been used in most of the examined papers. The age of participants in the studies varied from 7 to 86, but mainly young people formed the samples.

Technology Context or Modality

The examined studies used different modalities to develop gamification, which can be defined as game elements that connect games and players (Zeybek & Saygı, 2024). Modalities can be categorized into five general groups, which are shown in Table 1 with the frequency of their application in the studies. As seen in Table 1, more than half of the reported works used web applications, which, in some cases, include social networks as the medium. The wide use of web applications is due to the importance of social interaction in games and their development. Mobile applications, reported in 31% of the articles, are the second most used modality, which can be attributed to the increasing use of smartphones. Other modalities, including computer applications and bespoke devices, are also used, and there is a report of a game development with no digital element.

Table 1. Frequency of modalities

Modality	Frequency	Percent
Web application	28	58.33%
Mobile application	15	31.25%
Computer application	6	12.50%
Bespoke devices	3	6.25%
Non digital game	1	2.08%

Gamification elements

Studies have reported the use of different game elements as they are introduced to non-game contexts. Table 2 presents these game elements showing also the frequency of their application in the studied sources. As shown, 'point' with frequency of 75 percent (n=36) is the most frequent element compared to the rest of the elements. The reason may firstly, be its simplicity, and secondly is that this element helps to form other types of elements. For instance, when a leaderboard as a game element is used, a pointing system should exist to rank individuals on the board.

Table 2. Frequency of applied game elements

Game elements	Points	Badges	Leaderboards	Feedback	Rewards	Social interaction	Avatar	Levels	Challenges	Progress	Story/theme	Dashboard	Virtual goods	Combat	Content unlocking
Frequency	36	24	22	17	15	14	12	8	6	4	3	2	2	2	2
Percent	75%	50%	45.83%	35.42%	31.25%	29.17%	25%	16.67%	12.50%	8.33%	6.25%	4.17%	4.17%	4.17%	4.17%

Scope of Gamification

In the examined papers, gamification has been applied in different fields, as shown in Table 3 with the number of studies in each field; the percentage of each field is shown in Figure 2. Education is the most popular field of application, a trend likely associated with the tradition of using games in educational settings. Since the aim of gamification is to increase engagement by making activities more enjoyable, its application in education can enhance the appeal of teaching, leading to more effective learning. The field of Health is second in terms of gamification use, typically aiming to improve hygiene adherence, motivate increased physical activity, and support disease prevention. Approximately 13% of the studies addressed game elements related to Social Issues (n=6), indicating a notable area of application for gamification.

Table 3. Frequency of gamification field

Field	Education	Health	Social issues	Media	Computer science	Business	Environment	Banking
Frequency	21	9	6	5	4	1	1	1
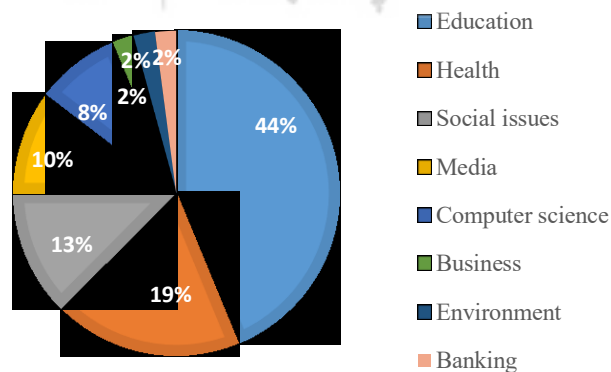
Figure 2. Fields of gamification for included papers

Coding

Meta-analysis is a robust statistical technique that allows researchers to combine and analyze the results of multiple studies on a particular technology or subject. It provides a highly accurate method to calculate the factors that influence technology adoption and use. By synthesizing data from several works that share a similar focus, researchers can obtain a more comprehensive understanding of the topic at hand. Furthermore, meta-analysis can help identify patterns, trends, and inconsistencies in the findings of individual studies, leading to more nuanced and insightful conclusions.

The implementation of this statistical method represents the most effective means of consolidating pre-existing research pertaining to the topic of gamification. As such, it supersedes the results of prior literature reviews, which were unable to present findings in a consolidated format. The deployment of this methodological approach enables researchers to present results in a clear, concise, and unified manner, thereby facilitating the identification of trends, patterns, and other relevant insights. It is thus recommended that this method be utilized in future research endeavors, particularly those involving gamification, to achieve optimal results.

Therefore, the meta-analysis method was used to analyze the data in this study. The units of analysis were sentences and paragraphs related to the subject of study. Coding was done manually using MAXQDA software. After examining the dimensions presented in the mentioned studies and focusing on the research field, we examined the main effective dimensions and components of the research model. In this article, data coding was done in three stages: open coding, axial coding, and selective coding, which we will further explore in the following sections. Open coding was used to identify initial themes, and then the main themes and relationships between them were extracted using axial and selective coding. To evaluate the validity of the analysis, the criteria of agreement between coders and reliability were used.

Discussions

A descriptive analysis of the literature was presented in the previous section, and the existing approach of the researchers and developers of gamification was explored. In this section, the guidelines are derived from the systematic review for the researchers and practitioners in gamification, achieved by reviewing the 48 studies and analyzing their results and recommendations for future work.

Recommended guidelines are described in the form of a new model for the strategic development of future gamification studies, as shown in Figure 3. For this model, three major concepts—context, user, and element—should be considered. Around these concepts, there

are six general guidelines for the entire process of the design and successful implementation of gamification, which are discussed in more detail below.

Context

Diversity of contexts

Empirical research has focused mostly on the areas of education (Auvinen et al., 2019; Ibáñez et al., 2021; Zeybek & Saygı, 2024) and health (Barratt, 2016; Carrà et al., 2019; González et al., 2016), and there is less research in other areas. The commonalities of the fields of education and health include the complexity and multidimensional nature of their activities, as well as the need for long-term continuity and engagement to achieve results (Koivisto & Hamari, 2019). According to the definition of gamification, which involves using game elements in non-game contexts, the context in which gamification is used significantly impacts the performance of the gamified system. Therefore, the findings made so far on gamification have been biased toward these areas (education and health), suggesting that many aspects of the concept are still not fully explored.

This issue affects other researchers and practitioners who aim to use gamification in less-developed areas because results from education and health contexts might not translate to other fields. However, in other important areas such as business and e-commerce, gamification can be effectively utilized. Given the limited research and existing literature gaps, these areas represent promising opportunities for further study. For instance, Albrecht et al. (2023) presented a project aimed at improving individuals' financial lives, and Magana and Munoz-Organero (2021) used gamification to promote eco-driving techniques, demonstrating a positive effect on changing drivers' behavior and increasing their interest in fuel economy.

It is worth noting that even in the most widely studied areas, research gaps persist; for instance, while many studies have focused on health-related concepts like fitness and physical activity programs (Zuckerman & Gal-Oz, 2014), several new and important fields remain underexplored. For example, hand hygiene awareness among nurses, a critical issue affecting morbidity and mortality rates, has seen only a few studies. Marques et al. (2019) adopted an innovative approach to gamification to increase hand hygiene awareness and help reduce hospital-acquired infections. Therefore, we suggest that future studies should focus on less-developed areas such as e-commerce, computer science, tourism, and banking. This will help prevent the bias of gamification findings toward a limited number of specific areas and explore the various dimensions of gamification across different contexts.

Scrutiny of context and generalization

The focus of many scholars on contexts such as education is controversial; in the field of education, it can be inferred that due to its specific nature, even before the advent of gamification, there were elements such as scores, leveling, and leaderboards. In fact, students

in the same class compete with each other to achieve higher scores, and at the end of the semester, they are ranked based on those scores and then promoted to the next grade (next level). Hence, gamifying this area is very interesting and practical, and it has attracted the attention of many scholars. However, gamification in other areas may not be as effective as in education, and it may be challenging to balance the principles of gamification with other contexts. For instance, in a context like e-commerce, users do not expect gameful interactions, unlike other popular gamified services like Foursquare. Since users in e-commerce are focused on trading goods and services and are not familiar with gamified systems, it is important to conduct future research in this area to examine the impact of integrating gamification with regular activities (Ibáñez et al., 2021).

In general, the effects of game dynamics on user engagement will vary depending on the goals of the gamification system. Suh et al. (2016) suggested that the model presented in their research was designed for information systems, and its performance in other areas, such as knowledge sharing, should be investigated. Similarly, Barata et al. (2016), in their study on education, suggested that further research should examine the applicability of their approach in other areas to improve it in different settings. In another study, Suh et al. (2019) showed that their study helps to better understand user engagement, but they emphasized that the impact of Aesthetic Experience varies depending on the goals of gamified information systems. Thus, they suggested that researchers investigate their research model in different domains and analyze its generalizability. Furthermore, Attali and Arieli-Attali (2015) focused on one particular domain in their research and predicted that their results would probably differ in other areas. This is also highlighted by Zuckerman and Gal-Oz (2014); given that the results of virtual rewards and social comparisons may perform differently in other situations, they suggested that their research be examined in different contexts, such as communal systems. Moreover, Rapp et al. (2019) demonstrated that for effective gamification to create a deeply engaging experience, understanding the context should precede the design phase of gamification. Finally, Koivisto and Hamari (2019) stated that a lack of contextual understanding reflects a deficiency in theoretical grounding.

Therefore, our suggestion for researchers and practitioners is to exercise caution when applying findings from studies conducted in different contexts. A solution that enhances effectiveness in one context may lead to user dissatisfaction in another. Additionally, an essential step before gamifying systems is to conduct a comprehensive review of the context and analyze all its aspects. This ensures that there is a good alignment between the context-specific items and the gamification elements, and that gamification is designed in a manner that respects the principles of that context.

Different conditions in each context

In a context, different conditions should be studied and the conditions under which the gamified systems work more effectively for individuals should be investigated (Hanus & Fox,

2018). In fact, the effectiveness of gamification will vary depending on the different situations, and to better understand the performance of the system, the usage situation should be evaluated in addition to comparing the game elements (Zuckerman & Gal-Oz, 2014).

Suh et al. (2016) showed that the impact of competition on qualifications may vary depending on different competition structures, and they suggested that future research examine the effects of various competition structures on gamified systems. In another study that has been done to improve driving habits to save fuel, the need to review different road conditions has been raised (Magana & Munoz-Organero, 2021). Similarly, Ibáñez et al. (2021) studied the learning effectiveness, engagement, and the use of gamification in C programming language teaching; It should be noted that their findings may not have the same results for other training courses and the condition of other courses should be considered. Furthermore, Su (2018) has launched a Gamification Software Engineering Education Learning System (GSEELS) to evaluate the impact of gamification; he has pointed out that it cannot be determined whether these results will be similar in other curriculum areas elsewhere in the world, and therefore he has recommended that more research should be conducted to compare competitive models with different population variables. It is also highlighted by Baptista and Oliveira (2017) that their research should be repeated to examine their results in different environments, technologies, and individuals.

In sum, future gamification research in taking advantage of existing studies of gamification literature should pay more attention to different conditions and situations for each specific context and it should be noted that the available findings for each context will vary for different conditions.

User

Individual characteristics

A key consideration in the design of gamified systems is the people who are involved in those systems. Different people have different goals (Koivisto & Hamari, 2019) and it is not expected that a certain kind of gamification design will be attractive and engaging to all individuals. However, most researchers have used the one-size-fits-all solution approach (Barata et al., 2016) in their studies so, they have ignored individual differences of users and their unique requirements (Hew et al., 2016; Vets et al., 2020; Wang et al., 2021). Since players are the main factors of a gamified system who should be provided with an attractive and fun setting to be motivated, it is necessary to pay attention to their individual characteristics and plan to meet their needs.

Regarding gaming motivations, researchers have shown that the drivers of the behavior are very diverse (Koivisto & Hamari, 2019), which is due to differences among various users. For instance, some people tend to get achievements by participating in gamified systems; some others are not attracted to achievement, and their goal is to engage in social

environments and communicate with others. Similarly, Auvinen et al. (2019) in their study of the effect of gamification in an online learning environment, have shown that, given the student's individual differences, providing the same type of feedback is not appropriate for all of them.

Jones et al. (2023) suggested that future gamification studies should examine the impact of the games on individuals; it should evaluate which individuals get the most benefit from gamification (Hanus & Fox, 2018). This requires closer attention to the player's differences and identification of their needs in gamified systems. Coombes and Jones (2020) have also suggested that tailored and individualized solutions will have a great impact on the performance of the systems in the design of the physical activity intervention based on the gamification that they have in their research, although at the community level interventions, a personalized design has a difficult and complicated process.

It is highlighted that the personalization of game systems would be more attractive if is consistent with personality traits and player types (Buckley & Doyle, 2017). Moreover, the impact of gamification on different individuals with unique and different characteristics will vary, and examining variables such as age, gender, and education will also have significant effects (Buckley & Doyle, 2017). El Tantawi et al. (2019) reported that women have a better performance than men in their study of gamification for the development of academic writing skills. Based on Baptista and Oliveira (2017), demographic characteristics such as age and gender can have a significant impact on users' acceptance of mobile banking. From another point of view, Suh et al. (2016) have shown that the differences in skill levels of different people also affect their engagement in gamified systems.

In order to design customized gamified systems, researchers can apply user segmentation (Carlier et al., 2019) and put users with common features in the same segment; then, according to their needs, they can provide appropriate gamification solutions; in this way, each segment would be identified as a special type of users. For over a decade, researchers have been studying different types of motivations and playing styles, and they have provided a variety of players' typologies (Tondello et al., 2017). This was systematically reviewed by Hamari and Tuunanen (2014) and they suggested five different dimensions, which include: achievement, exploration, sociability, domination, and immersion. From another point of view, Robson et al. (2015) identified four types of people to be involved in every gamified system: players, designers, spectators, and observers. Another perspective concerning the players in gamification, according to Bartle (1996), is the players' orientation and competitiveness. In this regard, four different types of players have been identified which include: strivers, scholars, socialites, and slayers (Robson et al., 2016).

In fact, a more accurate user categorization and presentation of a tutorial at the beginning of the experiment have a good effect on the performance of a gamified system (Carlier et al.,

2019). Magana and Munoz-Organero (2021) have also used gamification to improve drivers' behavior by clustering drivers based on their driving style. While the classification of players in gamification helps in the process of design to use appropriate game elements for different types of players, the examination of the literature of this study shows that researchers often use only one strategy to engage all players.

Therefore, designers need to have a thorough and comprehensive understanding of their users of gamified systems and the users' individual characteristics, such as their demographic and personality traits, along with their individual goals and needs, and design the system in a customized manner that would be attractive and engaging to everyone. It is suggested that a systematic review and comprehensive meta-analysis be conducted in this area.

Sample properties

Empirical studies that exist in the literature mostly use small sample sizes and present their results using a small number of participants (Barata et al., 2016; Gennari et al., 2017; Lin et al., 2015). For instance, Marcon et al. (2016) have introduced a novel approach to helping children learn how to brush their teeth properly, testing only seven children; Ibáñez et al. (2021) used only 22 students to study the effect of gamification on their Learning Activities; Chung et al. (2018) also used only 12 final samples to change the lifestyle of overweight adults and similarly, only 36 drivers were surveyed by Magana and Munoz-Organero (2021). In addition to the low volume of sample size, the lack of a control group can also be found in some studies (Carrà et al., 2019; Chung et al., 2018; Gennari et al., 2017), which makes it difficult to determine how gamified systems work in the target population.

Another point that can be found in some studies is that they usually examine their inquiries with current users and do not pay attention to nonusers, which makes the sample biased (Baptista & Oliveira, 2017). Suh et al. (2016) have used a biased sample of active members of the system and they suggest that in future studies, researchers should examine people who have abandoned their interaction due to negative experiences.

From another perspective, one of the limitations that exist in gamified studies is generalization (de-Marcos et al., 2019). Zuckerman and Gal-Oz (2014) used undergraduate students as participants in their research, which led to homogeneity and reduced variance; the participants have not been an appropriate representative of the general population and the researchers have therefore recommended that their studies be re-examined with a more heterogeneous sample. In another study, Christy and Fox (2022) often had young, college-educated women, leading that research results for other women with less education or other ages could not be generalized. Adukaite et al. (2017) also collected their sample from only three South African provinces, so their results could not be generalized to other nationalities.

It is suggested that researchers carry out future studies with larger and more diverse samples to increase the quality and accuracy of the results and instead of using biased samples, they try to use a wide range of participants so that their results can be generalized to other cases too.

Focusing on communities

Researchers have shown that gamification with cooperative game design has had better results than individual-based gamification efforts (Zeybek & Saygı, 2024), studies have shown that most gamification research has focused on individuals (Attali & Arieli-Attali, 2015; Barata et al., 2016; Boyle et al., 2017), and only a few studies have examined the effects of gamification on communities (Carlier et al., 2019; Rosani et al., 2020); so, literature such as crowdsourcing contains many gaps and numerous issues can be found (Morschheuser & Hamari, 2019).

Currently, in areas such as computer vision, some problems are difficult to solve with automatic algorithms but can easily be solved by humans, and in these cases, crowdsourcing techniques based on gamification techniques play an important role (Carlier et al., 2019). Rosani et al. (2020) have developed a gamification framework for event-saliency identification in images that uses crowdsourcing and crowd intelligence. Similarly, Badihi and Heydarnoori (2017) also used a crowdsourcing approach from a large number of developers to write code summaries. Simultaneously, Bujari et al. (2022) have used crowdsourcing and gamification to improve the quality of the system's response to discover cultural heritage locations.

In general, there are very interesting ideas for using crowdsourcing capabilities that require more scrutiny and closer focus. It is worth noting that other studies (Koivisto & Hamari, 2019) also acknowledge this point, and it has been shown that most of the elements are of interest to researchers who focus on the individual and that the elements of community participation, such as teams and social graphs are less widely used. While the games have a great deal of power to bring individuals together, it is expected that in gamification-based systems, which aim to use the elements of the game, researchers use these elements to bring people together and teamwork.

Using Crowdsourcing approaches to divide tasks into small sectors and distribute them among a large number of employees leads to attracting more users with higher commitment (Rosani et al., 2020); of course, there are important points to consider in the crowdsourcing approach, including the fact that crowdsourced tasks should be relatively simple and short;

They also stated that, since tasks are shared among different people in the community, researchers have to design tasks so that they are independent of each other. In addition, given that community size is usually so large that the individuals who perform the tasks cannot be

well understood, the system's reliability must be monitored closely (Carlier et al., 2019; Rosani et al., 2020).

Ultimately, the suggestion to gamified systems' designers is to focus more on communities, crowdsourcing, and collective capacity to advance their goals and achieve better results.

Elements

Diversity of elements

The studies we examined in this research often used a limited number of elements (Attali & Arieli-Attali, 2015; Auvinen et al., 2019; Davis & Singh, 2015) and because of the design simplicity of the gamification tools (de-Marcos et al., 2019) they are not indicative of all types of gamified systems (Hanus & Fox, 2018). While gamification means the use of game elements, and in games, there is also a lot of variety of elements, which has increased the attractiveness of the game for players. To meet the different psychological needs of individuals, gamification must generate a combination of diverse game dynamics (Suh et al., 2016); therefore, to achieve the desired result from gamification, a wide range of these tools should be used to increase the motivation and entertainment of the players (Hamari et al., 2018; Werbach & Hunter, 2022). This critique on gamification is known as "Pointsification" (Werbach & Hunter, 2022); it was precisely noted that in gamification instead of using elements of the game, designers superficially use only the points, badges, and leaderboards (PBL triad), while the games have a very large world that utilizes different elements and strategies that can be used to improve the interaction with users greatly. Especially, with the help of psychological discussions, different elements can be developed and improved by personal characteristics to enrich the gamification systems (Buckley & Doyle, 2017). In another study, Boyle et al. (2017) used only three elements in web-based personalized normative feedback (PNF) alcohol interventions for college students; they suggested that future researchers investigate participants using more elements.

Therefore, researchers in their future studies should examine a wide variety of elements, and it should be explained to the game designers that to increase the effectiveness of the gamified systems in their design, they should not suffice merely in a limited number of widely used elements.

Different conditions for each element

Another point in the gamification literature is that researchers often select gamification elements and evaluate them with just one or a limited number of similar methods (Attali & Arieli-Attali, 2015; Jones et al., 2023); while each of the game elements can be applied in a variety of ways. For instance, introverts are not keen on the element of a leaderboard, but extroverts have shown their satisfaction with using this element because of the desire to

participate in the dynamic social group and show off their achievements (Jia et al., 2016); by changing the way to use the leaderboard, it can also be appealing to introverted people. In this way, in the design of gamified systems, for introverts who are not interested in social networking, the leaderboard can be used with a close circle of well-known (and approved) friends instead of the entire community.

Similarly, Tondello et al. (2017) have shown that the preferences for reward and risk decrease with age; so, for younger people, elements can be designed to be reward-based and have a relatively high risk. On the other hand, for older people, another state of lower-risk elements can be used. In the same research, it has been shown that men tend to be more sociable and collaborative than women; this issue leads the designers to design different conditions of the elements that have stronger social aspects for men.

Therefore, it is recommended that in the application of game elements in gamified systems, their different conditions should be examined and the most effective mode should be selected for more engagement of the users.

Unique effects of elements

Many studies have examined the use of a set of gamification elements in non-game contexts and reported results in a general manner (Koivisto & Hamari, 2019; Wang et al., 2021). While some elements may have a positive impact and some hurt the gamified systems' performance, designers need to look at specific elements, instead of considering the gamification as an overarching concept, so that the unique contributions of each element (Jones et al., 2023), and the effectiveness of different mechanics should be analyzed separately (Hanus & Fox, 2018).

Wang et al. (2021) have reviewed the effectiveness of gamification, but their research does not specify the separate contribution of game elements to the extent of effectiveness, and they have recommended that future studies assess the individual effects of these game elements in terms of engagement and facilitating participation. Mavletova (2022) also suggested that in future research, the impact of each gamification element, such as rewards, narratives, and challenging tasks, on the quality of data should be explored separately. In addition to examining the impact of each element on an individual, one can examine the impact of each user's elements on other system users, such as the individual's acquaintances; in their upcoming research, Jin et al. (2020) are planning to review the positive and negative impact of each user's score on his friends.

Therefore, by examining the unique effects and contributions of elements, their effectiveness can be examined in the system, and it will be helpful to decide on their application in the design of the gamification. Even with the point that it is said about the various conditions of each element, it is recommended that the unique impact of the different

conditions of using elements should be investigated separately and a more comprehensive analysis of the operation of the elements can be provided.

General guidelines

Modern technology

With the advent of new technology and smart living, new horizons have emerged to develop a variety of new services (Sakamoto et al., 2016). However, most researchers did not have much interest in new game technologies to use gamification and the use of gameful elements (El Tantawi et al., 2019). Nevertheless, recently developed technologies such as augmented reality (AR) (Johansen & Dintenfass, 2019), whose successful examples have been confirmed by some researchers (Hwang et al., 2016), and similarly the use of wearable widgets for smartphones (Castellanos, 2016; Johnson et al., 2017) have opened a new horizon for gamification research. Using new technologies such as Gamified multimedia Geographical Information Systems (GIS)-based tools, data crowdsourcing for urban access can be enhanced (Prandi et al., 2022). Besides, technologies such as Smartphone GPS offer new approaches to physical activity and riding plans (Barratt, 2016). In another study, Chung et al. (2018) reviewed a mHealth intervention, which provided a novel combination of Fitbit as a wearable fitness tracker, using Twitter as a social media application and gamification, and achieved good results. It is also highlighted by El Tantawi et al. (2019), who studied the performance of students in the gamified course, resulted that the student's lack of interest in gamification and the lack of willingness to use it in other courses (despite students' improvements) are due to the technology, and they concluded that they probably had to use more technology support for the gamified course to attract the Internet generation.

Therefore, it is suggested that future research should take advantage of new technologies such as augmented reality and wearable widgets. In this regard, new concepts like the Internet of Things (IoT) can also be used to analyze the data exchanged between individuals and objects and increase the effectiveness of the gamified systems.

Success factors

Most of the studies in gamification literature have examined the effectiveness of using gamification strategies in different contexts (Coombes & Jones, 2020; Gennari et al., 2017). Even though doing this kind of empirical research is a great deal in enhancing the gamification literature in each certain context and guiding future research, there are only a few studies that examined the concept of gamification and determined the factors necessary for its success or failure (Koivisto & Hamari, 2019; Zeybek & Saygı, 2024).. This may be one of the reasons for the existing gaps and ambiguities in gamification; in fact, further analysis of the examined articles shows that gamification is not always improving the results and in some cases, undesirable results were achieved (Carlier et al., 2019; El Tantawi et al., 2019; Hamari et al., 2018).

In some studies that investigate the effect of gamification, due to the lack of strong concepts for this area and the limited experience of researchers in the design of gamified systems, poor gamification design is presented (Mavletova, 2022). Therefore, in gamification research, negative aspects and failure factors should be investigated and solutions should be presented to solve them (Wang, 2017). Furthermore, researchers have shown that more studies are needed to determine parameters such as the amount of required time for gamification projects, the number of users, as well as the number of optimal elements such as badges (Ibáñez et al., 2021).

In addition, in many studies, the methodologies are not well defined, which led to the elimination of a large number of investigations in our exclusion criteria. Koivisto and Hamari (2019) have also criticized providing descriptive statistics reports merely, and they emphasized that analyses of studies need to be more comprehensive and researchers should not only provide simple descriptions but also present clear and comprehensive reporting of their research.

Hence, researchers are expected to go beyond evaluating the effects of qualitative studies in future research, and, by carrying out conceptual and theoretical research, they will take steps to remove the vague points of the field and provide a comprehensive analysis of the success factors of gamification. Moreover, since gamification is a new field and all its dimensions are still not well-defined, it is suggested that researchers will have a more complete description of their problem, the elements employed, the research method, and, ultimately, the presentation of its results so that future researchers can appropriately use their results.

Dynamic design approach

In gamification design, studies often use several gameful elements statically (Mavletova, 2022; Rapp et al., 2019; Suh et al., 2016; Vets et al., 2020); while gamification has a dynamic approach and it works more complicated than linear systems. The use of static linear processes in applying reward-based elements in gamification creates challenges such as the "hedonic treadmill"; this means that when users are rewarded in a system, it should continue to do so; thus, if people learn to respond to the reward, they will only respond when rewards are provided (Werbach & Hunter, 2022). In gamification, this means that rewards should be designed in such a way that users are motivated to continue to interact with the system. If the rewards tend to become duplicative and boring, designers should consider adding new and more attractive rewards. This puts a lot of burden on gamification designers who need to constantly monitor this reward system and provide new and more attractive rewards dynamically.

Therefore, it is suggested that in the design of gamification, instead of using linear and static processes, dynamic and time-dependent processes should be used to increase the

effectiveness of gamified systems; in this way, it is possible to modify existing processes by receiving feedback from the system's users so that it has more engagement for users.

Timeframes

Many empirical studies of the gamification domain have been carried out in short periods (Christy & Fox, 2022; Magana & Munoz-Organero, 2021; Marcon et al., 2016)، and these short-term timelines are clear threats to the validity of the research findings (Koivisto & Hamari, 2019). Ibáñez et al. (2021) examined the short-term effects of gamification on the learning activity of Computer Science students in C programming language, and also pointed out that a long-term assessment will have a better understanding of the impact of gamification on students' learning outcomes. In another study, Magana and Munoz-Organero (2021) have considered the driver's behavioral change system for three months which is relatively short in the field of behavioral change. To change the behavior of users in a consistent and sustained way, solutions should be considered for their long-term engagement (Ribeiro et al., 2020). It is also emphasized by Christy and Fox (2022) that longitudinal controlled experiments should be used in gamified systems research.

Generally, some studies have shown that their outcomes may change in the long run (Hamari, 2023; Koivisto & Hamari, 2014); it has shown that the positive effects of gamification have been short-lived even for boring tasks (Koivisto & Hamari, 2014), and in the gamified systems, the engagement of participants decreases over time (Zeybek & Saygı, 2024). Jones et al. (2023) expressed their short period of research time as one of the limitations; hence they stated that their game may have no lasting effect and therefore they suggested that long-term effects require long-term intervention. Furthermore, Zuckerman and Gal-Oz (2014) who investigated an application for 10 and 14 days in their research, suggested that social comparisons and virtual rewards would probably not be equally effective in a long-term intervention.

The change in the level of engagement and interest of individuals towards gamified systems over time may be due to the novelty effect. Engagement comes to the forefront with new technologies such as gamification as soon as the technology is introduced, and then gradually decreases over time (Zuckerman & Gal-Oz, 2014). Interestingly, if all the users of the system were gamified at the very beginning, they would lose interest with a high probability in a shorter time (Hanus & Fox, 2018). To create long-term motivational benefits of gamification, it is possible to take advantage of the benefits of social networks (de-Marcos et al., 2024).

For this purpose, it is suggested that researchers increase the time scale of gamification studies and use methods such as follow-up research to study longitudinal gamified systems so that they can investigate individuals after some time and determine the impact of the gamified

systems on them. This can provide useful information concerning the users' emotions and preferences about gamification.

Decision-making methods

In gamification studies, there is limited information about designing strategies and choosing elements; many researchers have focused on putting gamification in a non-game context and they have examined how far the system has been affected (Christy & Fox, 2022; de-Marcos et al., 2024; Hew et al., 2016; Jones et al., 2023); while the details of how the gamification designs have a significant impact on the final results and there are a lot of points to consider to design successful gamified systems, otherwise, failure of the gamification is predictable. For instance, the results of Hanus and Fox (2018) assessing the effects of gamification in the classroom showed that students in the gamified course had less motivation, satisfaction, and empowerment than the non-gamified, and had lower final exam scores. The mere implementation of gamification mechanisms does not automatically increase the engagement of users (Hamari, 2023). Thus, to design successful gamified systems, a suitable selection of appropriate game elements must be made for each particular context (Rapp et al., 2019).

Therefore, due to the novelty of the concept of gamification and the limited information available, when designing gamified systems and selecting the elements of gamification, one should carefully consider all aspects, and the researchers should focus on decision techniques of gamification design, and choosing the right elements as well as providing the desired strategies.

Validation methods

The latest issue in the study of gamification research is that, despite the many studies carried out in this area, there is still no comprehensive analysis of the validation methods of these systems; while investigating the results of the gamified systems and measuring their effectiveness, researchers need to identify and review different types of validation methods. Gennari et al. (2017) mentioned the lack of methods for assessing products and the lack of a standard measurement and evaluation approach as their research limitations. There are some validation methods provided by researchers, for instance, Magana and Munoz-Organero (2021) using fuzzy logic, designed a validation method to validate the effect of gamification on user behavior; the criteria presented are: Percentage of sudden de/acceleration, Standard deviation of the vehicle speed, Percentage at high engine speed, Percentage at high speed, PKI. In another study in the field of education, using criteria such as earliness (mean interval of submission to deadline, number of attempts per exercise, completed exercises, and improvement), the effect of gamification on student behavior has been investigated (Auvinen et al., 2019).

It's worth noting that the current way of validation in many research is by measuring the users' satisfaction with the system, as well as examining their emotions and engagement

(Codish & Ravid, 2022). In addition, many studies have used self-reported methods to examine users' emotions about gamification elements and their preferences (Baptista & Oliveira, 2017; Carrà et al., 2019). However, in self-reported methods, people may not have a proper understanding of the concepts presented at the time when responding to survey questions, and therefore the opinions they provide may not be highly accurate. Individuals may also not be able to properly determine their feelings about the statements in the survey when answering the questions. When using the survey to review the views of individuals, which they provide about each of the concepts asked in the survey, it may only be the individuals' initial perception that is different from mature thinking, which is formed over time and after long-term use of these elements; because habit formation is a long-term process and people in different periods may have different behaviors toward gamification elements (Jia et al., 2016). Wang et al. suggested that to measure individuals' perceptions more precisely, multiple-method and multi-source approaches are needed, and individuals' in-game behavioral data and game activity logs such as time spent and the number of tasks completed in the game can be used as a measurement and validation indicators (Wang et al., 2021). Rapp et al. (2019) have also shown that the use of qualitative research and contextual interviews along with log analysis is necessary to evaluate the degree of engagement of gamified systems. Moreover, it is recommended by Suh et al. (2019) that objective data should be used in future studies to resolve the common method bias (CMB) concerns.

From another point of view, gamified system validation should be done in a multi-step manner and it should be considered whether changes in the behavior of users after the removal of the system have been made; for instance, according to Magana and Munoz-Organero (2021), it should be checked whether, after turning off the embedded system, the drivers continue to maintain the good driving habits they find or go back to their old style of driving.

Hence, it is suggested that researchers in future studies carry out comprehensive research in the field of different types of validation methods for gamified systems and provide a proper category for them. In addition, to investigate the effectiveness of gamified systems, besides individuals' self-reported views, the actual behaviors of individuals when interacting with gamified systems should be considered and the relationship between their views and their actual behavior should be examined. Meanwhile, to investigate whether the changes made by the gamification to the system users are persistent or the effect is lost, it is recommended to use multi-step validation methods.
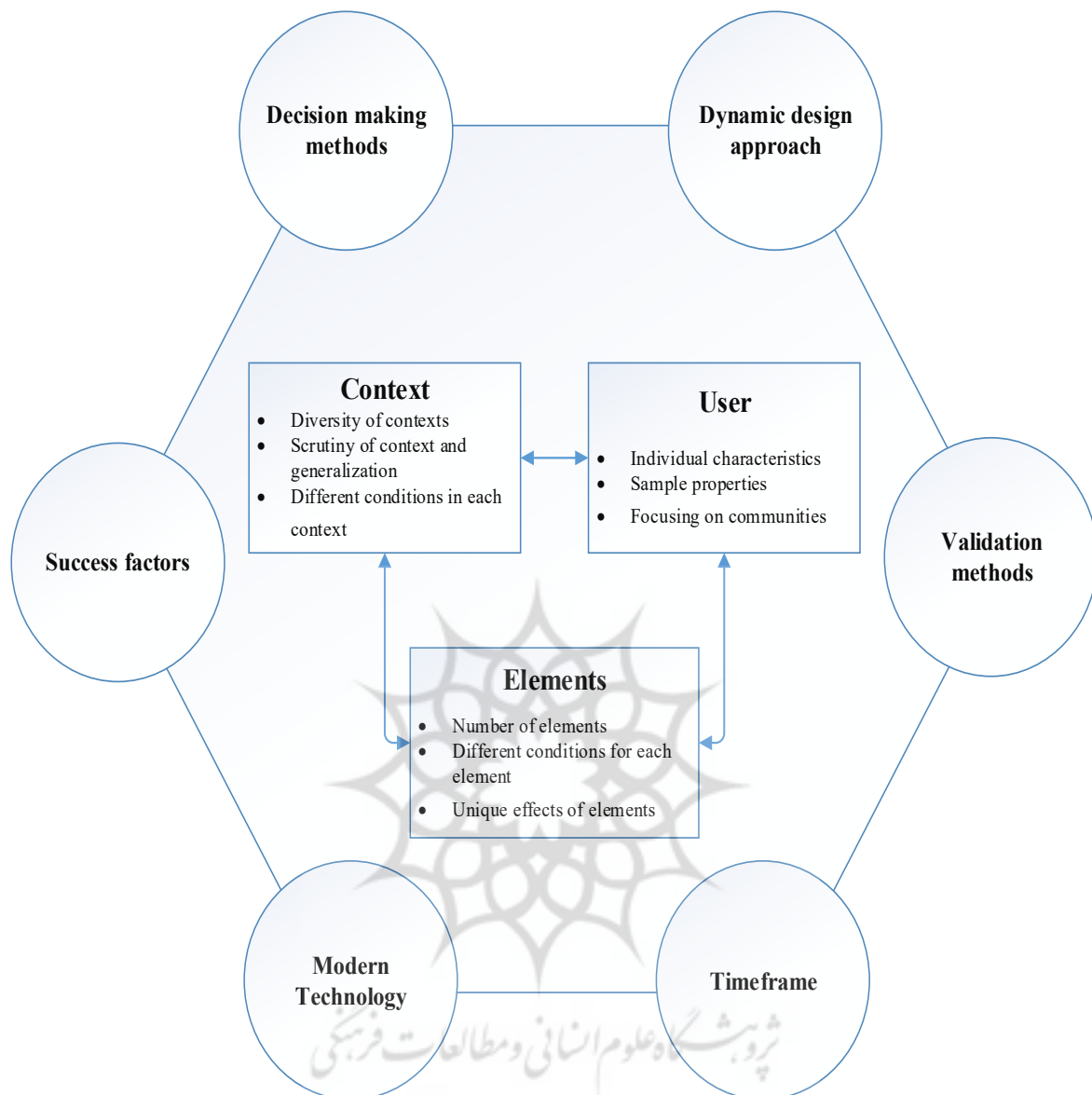
Figure 3. Our new model for the strategic development of future gamification studies

Scientific Implications and Practical Applications

In this study, we present a new model for the strategic development of future research in the field of gamification, focusing on three main dimensions: contexts, users, and elements. The proposed model can assist designers of gamification systems to create more precise and tailored systems according to the needs of users and specific contexts. This model not only provides a deeper understanding of gamification systems but also offers perspectives and practical guidelines for academics and professionals in this field.

Our research indicates that gamification can have extensive impacts in various fields, including education, health, and business. Implementing our model can lead to increased engagement and commitment from users, which in turn has positive consequences for

improving learning processes and business productivity. Furthermore, a focus on sustainable and continuous development of gamification can help create more innovative solutions for solving social problems.

For future research, it is recommended that researchers focus on assessing the effectiveness of the model in less-studied areas such as e-commerce and tourism. Additionally, studying the cultural impacts of gamification and adapting the model to different cultural contexts can lead to a better and more comprehensive understanding of how gamification affects various users. This not only aids in improving future designs but also ensures that gamification effectively and appealingly meets the diverse needs of users.

Despite promising results, our research has limitations that must be considered. The model used may not be equally effective in all contexts or for all users. Therefore, more research is needed to evaluate the capabilities of the model under different conditions and contexts.

Conclusion

Today, in various domains such as education, health, and business, gamification has been used to enhance engagement and increase the efficiency of systems. Despite the considerable attention of researchers to gamification, the good efforts that have been made in this area, and the positive results that have been achieved in research, many cases have resulted in undesirable outcomes when using gamification. One reason for the improper performance of gamification is that many aspects of this field have not been discovered yet, and biased research seems to be advancing. Therefore, there is a pressing need for a comprehensive review of the studies so that guidelines for future research will be presented and the less-developed dimensions of gamification will be more considered by researchers in this field. Hence, in this research, we offer a systematic review of the literature available on the emerging and growing subject of gamification. For this review, various databases were scrutinized, and eventually, a list of 48 gamification studies was obtained and examined from various aspects, such as sample properties, modalities, gamification elements, and applied fields.

The results revealed that most papers lacked sufficient information about participants and their inclusion criteria, and no particular special method has been used in most of the examined studies. Moreover, investigating the technology context or modality, we divided the research into five categories, showing that most research uses web applications, which include social networks as the medium; after that, mobile apps take second place. Then we obtained the frequency of gamification elements used in the studies and showed that the point element was the most popular; this could be the result of its simplicity or because this element helped to form other elements; next, the elements of badges and leaderboards were the most

repetitive. Finally, we examined the scope of gamification and showed that education and health are the most popular fields of application.

According to the reviews, we presented a new model for the strategic development of future gamification studies, which discusses three main dimensions of context, user, and elements, and six guidelines provided around these dimensions: decision-making methods, dynamic design approaches, success factors, modern technologies, timeframe, and validation methods.

We should expect future research to address these issues in further detail. Compared to other systematic reviews on gamification, our contribution is presenting a novel model that highlights less focused and important areas of gamification and takes them into more consideration. By focusing on the dimensions proposed in this model, researchers will achieve more findings in gamification. Finally, considering the proposed model in the design of gamification can help enhance individual engagement, which is the main goal of gamified systems.

Conflict of interest

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

Funding

Appendix A

A summary of gamification studies included details and outcomes

Scope of Gamification	Reference	Aim(s) of study	User Context (or Sample size)	Gamification elements	Technology Context (or Modality)	Results	Future Research
Peer-to-peer trading service	(Hamari, 2023)	Investigating the effect of badges on a gamification utilitarian peer-to-peer trading service	3234 users of the Sharetribe Aalto University site	Badges	Web site (Sharetribe)	It is concluded that the mere design and implementation of gamification spontaneously do not significantly increase in use activity in the studied utilitarian service. However, gamification had better results for the users who actively monitored their badges.	Examining the effect of temporal differences in implementation on technology acceptance of gamified features.
Education	(Codish & Ravid, 2022)	Recognizing playfulness in an educational course in gamified LMS	38 students of industrial engineering and management, age: [23-30], (17 male- 21 female)	Leaderboard, Point, Badge	Web site (an academic course in a Learning Management System (LMS))	Actual behavior especially certain gamification behavior patterns can predict playfulness better than personality traits and enjoyment from game elements. Applying gamification, students with learning disabilities and female students can enjoy more.	- Gamification Behaviors Database - Adaptive gamification - Higher sample sizes - Study more about students with learning disabilities
Social issues	(Albrecht et al., 2023)	Presenting a model followed by a gamified prototype according to consumer's perspective	More than 100 participants at the Amplify Festival Expo	Levels, Win states, Challenges	Mobile Application (gamified prototype on tablets)	A comprehensive, integrated, and interactive financial plan is presented that is used competitively to increase gamification behavior	Extend the initial presented prototype
Environment (Save Fuel)	(Magana & Munoz-Organero, 2021)	Using gamification to save fuel, reduce drivers; bad habits, and improve them through eco-driving	36 participants as driver	Leaderboard, Badge, Point(score), Feedbacks	Mobile Application (Android) and OBDLink OBD Interface Unit from ScanTool.Net	Applying tools and techniques of gamification helps eco-driving and helps drivers save fuel and leave their previous bad habits in driving	- a larger number of drivers, Longer periods of time, under different road conditions, Only employing the sensors from the mobile phone -Check whether the drivers of the project return to their bad habits after participation.
Media (Event Detection)	(Rosani et al., 2020)	Extract reliable event saliency maps from images by gamification	more than 300 master's and PhD students	Point, Leaderboard	Web application (eventMask)	- Producing a does saliency map focus on event-related semantics of media - An event-saliency Dataset (EventMAsl) presented for future studies	More sophisticated uses of the saliency information can be thought

Education	(Ibáñez et al., 2021)	Explore the impact of gamification techniques on students' cognitive engagement and learning about C-programming language	22 undergraduates engineering students age: [20-25], (17 males, 5 females)	Points, Badges, Leaderboard, Social interactions	Web and social network applications (Microblogging Area)	Gamified learning activities had positive effects on the engagement of students and a moderate improvement in learning outcomes such as knowledge of the C-programming language, badges were the most successful game element	- Determine parameters such as the time, No. of students, optimal No. of badges that - Long-term evaluation of learning outcomes - Clarify whether rewards can reduce internal motivation.
Education	(Auvinen et al., 2019)	The effect of students' behavior on their behavior in an online training course	Students of Data Structures and Algorithms course: 254 students in badge study 215 students in heatmap study	Badges, Dashboard, Progress bar, Feedback, Reward	Web application (online learning Environment)	The results showed that students' behavior visualization can affect their behaviors even if they do not get tangible rewards; this increasing students' awareness of their behavior has a positive effect on their ranks and assignments. Heat map visualization affects the sending time of assignments.	determine the effects on individual students rather than the average difference between treatment and control find ways to support - low-performing students
Education	(Barata et al., 2016)	Prediction of students' performance due to the differences between different people	76 students in a college course (67 males, 9 females)	Leaderboard, Badge, Points, Unlock	Traditional classes and an online learning platform (Moodle platform)	Students' type can be predicted only by performance data with an accuracy of 79%. However, in the early steps of the course, students' performances were less different and the power of its prediction can be increased by merging or player-type data	- Larger sample size - experiment and improve the presented approach in other settings - Adaptive gamified learning environments
Computer science (Programming)	(Badihi & Heydarmoori, 2017)	Applying Crowdsourcing, Gamification, and Natural Language Processing to make automatic high-level summaries in Java programs	149 undergraduates and graduate students of Sharif University of Technology	Points, Levels, Leaderboard, Badges, Progress bar, Avatar	Web-based application (named: CrowdSummarizer)	Most of the experts are satisfied with summaries and Crowdsourcing can be used by developers and to automatic creation of comprehensible summaries. Using human intelligence can help with code summarization.	Implementation of CrowdSummarizer in other programming languages such as C++. The effect of this method on software maintenance.

Social issues (Web survey)	(Mavletova, 2022)	The effect of gamification in web surveys on children	1,050 children [7-15] years	Avatar, Narrative, Points, Feedback, Levels, Challenges	Web site (an online access panel)	Gamified questionnaires were easier and more enjoyable for children and in some cases, they contained better results than the two other questionnaires.	- More research is needed on the effects of gamification in web surveys, in which their respondents are children. This research should be done on the children who use the internet less than the others. measuring the effect of gamification elements on data quality
Health	(Chung et al., 2018)	Combining Fitbits and Twitter with gamification to foster healthy lifestyles	12 participants (4 males, 8 females)	Feedback, Challenges, Social interaction	Mobile and desktop applications (Fitbit), social network (Twitter)	The proper combination of Fitbit as a wearable fitness tracker, Twitter as a social network as well as gamification improved healthy lifestyle behaviors and successfully increased physical activity	- Use the control group as a comparison - Add a definitive way To make sure participants read all the Tweets sent to them
Education (Writing skills)	(El Tantawi et al., 2019)	Assessing the satisfaction of students with gamification and its effects on writing skills	92 dental students (47 males,45 females),	Storyline, Feedback, Point, Badge, Leaderboard, Teams	Web application (Learning management system LMS)	Students' academic writing skills were improved by using gamification and their satisfaction with game elements was modest, and finally, their attitudes to using gamification were low for the next courses.	The effect of gamification on other fields of learning considering students at higher program levels
Mobile Banking services	(Baptista & Oliveira, 2017)	The potential effect of gamification on the acceptance of mobile banking services	Brazilian ٣٢۶ bank customers	Social interaction	Mobile application	The results show that there is a direct relationship between gamification and attitudes to use mobile banking services, Besides, increasing customer satisfaction gamification makes banking services more enjoyable	Replicated study in different environments, technologies, and individuals; Research more on risk and trust, as a key predictor of consumer attitudes
Computer science (Information systems)	(Suh et al., 2016)	How gamification causes the increase in user engagement in information systems	164 users (88 males, 76 females)	Points, Levels, Badges, Leaderboards, Avatars, Emoticons, Virtual gifts	Web site (gamified knowledge-sharing website)	Resolving psychological needs, gamification can increase user engagement	Examining this model in other domains; Examining the effect of different competition structures on competence; Using samples that are less active in online environments
Media (Human computation systems)	(Wang et al., 2021)	Effectiveness as perceived engagement and user acceptance, and examined it by comparing the performance of a gamified human computation system	95 participants (60 males, 35 females)	Points, Leaderboard, Ranking, Social interaction	Web application (a gamified human computation system (HCS))	Experienced more engagement and showed higher behavioral intentions toward the gamified system	Research on Investigating participants' actual adoption behavior; Take individuals' in-game behavioral data as indicators (not just self-reported data)

Domain	Reference	Purpose	Sample	Game elements	Platform	Findings	Future work
Computer science (information systems)	(Suh et al., 2019)	The function of gamified IS in the workplace and flow experience (FE) and aesthetic experience (AE) is to engage the users	178 employees of a global consulting company (105 males, 73 females)	Points, Levels, Badges, Trophies, and Leaderboards	Web application	Aesthetic experience (AE) is more salient than flow experience (FE) for continuance intention	More attention on meaningful engagement characterized by AE (instead of deep engagement characterized by FE)
Social media	(Rapp et al., 2019)	A new methodology for field evaluation of a social media and application gamified formative evaluation of a prototypical social system	157 participants	Points, Rewards, Leaderboard, Social interaction	WantEat: an intelligent mobile application in the gastronomy domain	Gamifying a field evaluation of a social application prototype is feasible and requires low costs and short-term studies to be conducted	Using a proper control group to ensure whether adding game mechanics in a field evaluation format can increase users' participation.
Health (Nurses Hand Hygiene)	(Marques et al., 2019)	Presenting gamification solution to provide healthcare workers (HCWs) real-time feedback on personal hand hygiene (HH) compliance	6 nurses working in the Intensive Care Unit (ICU) of a Portuguese tertiary hospital.	Badges, Virtual goods, Avatar, Leaderboard, Dashboard, Feedback, Progress bar, Point, Content unlocking	Computer and mobile application	Combining automated monitoring systems with gamification contained good results. Entering nurses from the early stages of the work makes their need to be considered. The nurses enjoyed the solution and their awareness increased.	- Testing and improving indoor location technologies
Social issues	(Jin et al., 2020)	The effect of user scores as a social gamification mechanism in Foursquare	10,254 users	Leaderboard, Points, Social Interaction,	Social network	Recognized effect on the user scores implicates some applications such as friend and venue in recommendations LBSN	The positive or negative effect of the user's scores on his/her friends. Using positive/negative effects among users to increase venue and friend recommendations
Health (Physical activity)	(Zuckerman & Gal-Oz, 2014)	effect of The two famous game elements persuasive systems: virtual rewards and social comparison	Study1: 40 Participants (28 males and 12 females) Study 2: 59 undergraduate students (44 females,15 males)	Points, Feedback, Virtual rewards, social interaction, Leaderboard	Mobile application (StepByStep)	Quantified elements increased walking time. Gamified elements are as effective as quantified methods by presenting virtual rewards and social comparison.	Empirical effect of meaningful or user-centered measurement; Evaluation of the usage situation to examine the effect of virtual rewards and social comparison.
Media (Music improvisation)	(Vets et al., 2020)	Presenting a Realization of an interactive multimedia installation to create Gamified music improvisation	241 participants (189 males, 52 females)	Reward, Audio-visual feedback	Billiard table (BilliArt: artistic collaborative environment)	The ability of interactive multimedia installation to activate users' sense of aesthetic rewards led to their increasing engagement in the game.	The outcomes of this study can be used in human-computer interaction, interface design, and cultural heritage preservation.

Social issues	(Kundisch & von Rechenberg, 2016)	Using virtual reward on user engagement in small area hypothesis	650 German Question & Answer community users	Virtual rewards, Points, Badges	Web application (Question & Answer community)	Framing of progress towards virtual rewards increases and affects user contribution.	Executing a two by two-by-two randomized experiment that examines the progress of low vs. high and farming of accumulated vs remaining. Examining whether farming in progress in large numbers is more effective than that in small numbers.
Education	(Wang, 2017)	Creating an immersive 3D learning environment using game elements in virtual exhibition to increase learning performance	20 students (11 males, 9 females)	Point, Battle (Combat), Avatar	Web application (via combining Maya, Unity, and JanusVR)	Compared with traditional teaching and online web pages, virtual exhibitions attract students and increase their attitude to learning history.	Thorough study of virtual environment focusing on avatars, collaborative tasks, etc. Developing interactive, personalized gamified learning on campuses because of differences among students. Making an independent toolkit for teachers to create effective and dynamic exhibitions. Analyzing negative aspects of educational games and presenting solutions for them.
Education	(Nobel-Jorgensen et al., 2016)	Increasing topology optimization using game elements	48 students	Challenges, Levels, Points	Web & mobile application (TopOpt: An educational game for iOS and PC)	In the new method of education, a typology optimization is presented; it was shown that the more players play, the more experiments they achieve and they get higher scores.	Designing more simple games causes players to think less and results showed more joy through this method. Making 3D visualization
Social issues	(Bujari et al., 2022)	The system aims to take feedback by motivating users and apply those feedbacks to improve outcomes that interactive online service shows to tourists.	110 users	Points, Badges, and Leaderboards (PBL), Social interaction	Web & mobile application, (PhotoTrip)	Social networks, crowdsourcing, and gamification motivate users effectively and increase the quality of system responses.	Increasing the number of images retrieved through an online translation service to translate automatically the tags between the English and the language of the visited country.

Domain	Reference	Objective	Participants	Game Elements	Application	Findings	Future work
Software engineering education	(Su, 2018)	Developing a Gamification Software Engineering Education Learning System (GSEELS) as well as the effect of gamification, learning motivation, cognitive load, and learning anxiety on academic performance.	107 undergraduates (46 males, 61 females)	Avatar, Points, Rewards, Feedback	Computer application	A well-designed GSEELS would affect student learning motivation and academic performance and the relationship model between gamification learning, learning motivation, cognitive load, learning anxiety, and academic performance is explicated.	Comparing competitive models with different demographic variables on gamification academic performance. with gamification learning strategy using the gamification teaching strategy mentioned in this paper
Media	(Carlier et al., 2019)	Using gamification and crowdsourcing image for processing and object segmentation	Click & Cut: 15 Experts & 20 workers Ask & Seek: 162 Players	Points,	Computer & web-based application (Click & Cut, Ask & Seek)	Two concepts of gamification loss and crowdsourcing loss were examined and it resulted that the quality in the gamified version is almost half of the one in the tedious version.	Based on users' feedback, object segmentation algorithms should be presented by automatic categorization of users Automatic tag selection instead of manual selection to increase accuracy
Social issues	(Prandi et al., 2022)	challenging the intuition of exploiting the zombie genre as an apotropaic medium in improving civic engagement	50 walkers	Challenge, Rewards, Points	Multimedia mobile application (Geo-Zombie)	Geo-zombie is a multimedia mobile application, which results better in urban accessibility by transporting mapping activity and motivating players to gather data	The study presents some reflections on to use of fun applications for urban data crowdsourcing.
Social issues	(Sakamoto et al., 2016)	To use the power of gameful digital rhetoric to influence collective human behavior in crowdsourcing	11 people (8 males, 3 females)	Rewards, Points, Badges, Feedback, Social interaction	Web and mobile application	The proposed approach was effective on collective human factors to improve digital social services.	Conducting this research on a larger sample size and critical insight is an effective strategy to advance future research
Education	(Gennari et al., 2017)	Assesses how children perform in participatory game design	35 students of a primary school (14 males, 21 females)	Feedback, Progression, Badges, Rewards (coins)	Computer application (GaCoCo)	Useful insights were presented for participatory game design with children.	By increasing the time of oral feedback, experts can find proper information about game elements that have been used by children.
Health (cancer prevention)	(Ribeiro et al., 2020)	Exploration of experiences and insights into cancer prevention app users who are looking for change	16 healthy young adults	Virtual badges, Social interaction	Smartphone application	This study sets guidelines for the development of cancer prevention applications. Long-term users did not put great importance on gamification.	Using these guides in happy health awareness

Health (alcohol intervention)	(Boyle et al., 2017)	The effect of gamified PNF alcohol intervention on college students	237 college students	Point-based reward system, Avatar, Chance, Social interaction	Social game (campusGander)	CampusGander was significantly more effective at reducing student drinking behavior than was standard PNF.	Examining of economic benefits and methodology of gamified PNF intervention. Using other game elements such as levels leaderboard and in campusGander
Health (Physical activity)	(Coombes & Jones 2020)	The effect of Beat the Street on active travel to school	80 children [8–10] years	Point	Accelerometer	No evidence of a large intervention effect of Beat the Street	What are the consequences of increasing engagement in intervention?
Health (Cycling)	(Barratt, 2016)	How does motivation to exercise affect the daily exercise of cyclists? negative consequences of gamification	20 club-level cyclists	Points, Badges, Leaderboards, Progress bars, Quests, Meaningful stories, Avatars	Mobile application (Strava), Cycle computers, GPS trackers	The paper shows how practitioners engage with the activity-tracking app and demonstrates the dynamics of sociotechnical change and engagement with technology in contemporary cycling	Conducting more research on health policy aims and positive outcomes Examining whether using apps such as Strava increases sexual differences and causes female disadvantages.
thoracic surgical education	(Mokadam et al., 2018)	Developing a gamification strategy to stimulate residents and trainers to increase simulation training	60 participants	Score, Ranking	Computer application (Simulator Top-Gun)	This gamification approach has been successfully implemented, and has encouraged the use of simulators and the Thoracic Surgery Curriculum & focused on technical and cognitive skills	Increasing fidelity transferability of simulators into the operating room environment, and local adoption
Education	(Jones et al., 2023)	Explore a low-cost game-based intervention to increase fruits and vegetables consumption	251 elementary school students	Rewards, Fictional Narrative, Badge (whimsical medal)	Physical game: FIT game	Fruits and vegetables consumption increased by 39% & 33% respectively, applying gamification	1- Future studies should evaluate the unique contributions of each of the game elements. 2- Future studies should evaluate the effects of the game on individual consumption.
Education	(Lin et al., 2015)	Presenting a novel gaming platform to assess surgical decision-making & improve operative judgment	49 participants	Point system, Feedback, Levels	Web-based virtual patient simulator platform (SICKO)	SICKO is an engaging and immersive educational tool and it can help to conduct a valid assessment of the armamentarium of surgical educators.	Examining SICKO on larger study cohorts and doing a more detailed analysis of internal structure game metrics among different levels of expertise.
Health (Oral hygiene)	(Marcon et al. 2016)	Present a novel approach to analyze the tooth brushing procedure	7 children	Avatar, Feedback	Smartphone/ tablet, a cheap toothbrush accessory	Analysis and proper oral health education to children and the right way to brush.	Longer apply the proposed algorithm for better results.
Health	(Carrà et al., 2019)	The effect of a novel, self-administered e-health app on Binge Drinking	590 Young peoples	Feedback	Mobile application (D-ARIANNA)	Provides evidence of population-level benefit attained with D-ARIANNA which contains longer effect applying gamification.	Adding a control group to this study and conducting long-term research to achieve better results.

Category	Reference	Title	Participants	Game Elements	Platform	Results	Future Work
Education	(Hew et al., 2016)	The effect of game mechanics on student cognitive and behavioral engagements	22 graduate students (8 males, 14 females)	Points, Badges, Leaderboard	Web Application (Moodle: a learning management system)	The study contains empirical evidence that shows using game elements has a positive effect on student motivation to perform more difficult tasks.	Using other game mechanics such as narrative and examining their effect on student engagement during a long term (e.g. 1 year).
Education	(de-Marcos et al., 2024)	Comparing gamification and social networks in e-learning	114 students in Gamification 184 students in Social network	Leaderboard, Badge, Reward, Social interaction, Points	Web application, (Learning management systems)	Presented gamification and social networks were more effective rather than the two traditional methods, but traditional approaches of e-learning were better in knowledge assessment.	Applying both gamification and social networks instead of using one of them; and social gamification of e-learning contains better results.
Education	(Filsecker & Hickey, 2023)	The effect of external rewards on motivation, engagement, and learning when using an educational game	106 participants (50 males, 56 females)	External Rewards, points, Avatar badges, Leaderboard, Feedback	Web Application (Taiga)	External rewards had no significant effect on motivation, engagement, and learning in the Taiga educational environment.	Understanding basic educational processes, especially in motivation and engagement.
Education	(Hanus & Fox, 2018)	Investigation of the effect of gamification on motivation, social comparison, effort, satisfaction, learner empowerment, and academic performance of students	80 students (57 males, 23 females)	Leaderboard, Badges, Reward (coin), Point, Competition	Computer application	Students in the gamified course showed less motivation.	Investigate the effectiveness of specific elements of gamification -Consider gamification elements with positive effects -Consider interactive technology and digital mechanics to create gamified systems
Education	(Christy & Fox, 2022)	The impact of leaderboards on academic performance	80 female undergraduates	Leaderboard, Avatar, Points	Web Application (virtual classroom)	The use of leaderboards in academic environments can affect academic performance	Using feedback as game elements to participants. Examining students' performance according to their position on the leaderboard and its consequences.
Tourism education	(Adukaite et al., 2017)	The effect of gamification in tourism using education determined predictors	209 tourism teachers (35 males, 174 females)	Reward, Feedback, Score (point)	Web application	Both playfulness, and curriculum fit have a positive, the direct impact on construct of behavioral intention while the exogenous constructs of self-efficacy, computer anxiety, challenge, and learning opportunities have an indirect effect on behavioral intentions.	Offering a combination of qualitative and quantitative research in the longer run

Education	(Buckley & Doyle, 2017)	The effect of personality traits and learning styles on gamification	158 junior students in Business	Avatars, Badges, Collections, Combat, Content unlocking, Leaderboard, Level, Points, social interaction, Virtual goods	Web application	Depending on individual attributes the experience of gamification varies	- Future studies assume gamification as a suite of tools for behavior change. - The effects of other variables such as age, gender, and education should be noted in future research.
Education	(de-Marcos et al., 2019)	The effect of gamification and social networks on learning	379 students at an undergraduate course on ICT qualification	Challenges, Badge, Leaderboard, points, Social interaction	Web applications (Educational game: Ribbonhero social network: Elgg)	All experimental conditions (educational games, gamification, social networking, and social gamification of learning) significantly impact on learning performance.	Future studies can focus on the combination of gamification and social networks. Moreover, focusing on the influences of gamification on social networks as well as the effects of position in social networks on learning performance provides interesting grounds to study.
Education	(Attali & Arieli-Attali, 2015)	The effect of Point as a game element on gamification performance assessment	Study 1: 1218 participants from Amazon's Mechanical Turk (MTurk) crowdsourcing marketplace Study 2: 693 students of middle school	Points, Feedback	Web application (CBAL)	In both studies, points condition did not affect the accuracy of individuals, but the speed of responses was increased when scores were considered. Middle students often tend to get scores and these scores affect their interest in tests and perceived efforts.	Conducting long-term studies on other domains (e.g., non-analytical content areas)

References

Adukaite, A., van Zyl, I., Er, Ş., & Cantoni, L. (2017). Teacher perceptions on the use of digital gamified learning in tourism education: The case of South African secondary schools. *Computers & Education*, *111*, 172-190.

Albrecht, S., Bonti, A., Dhaliwal, J., Giaimo, F. M., Känel, J. v., Pandey, S., Phan, A., & Wang, Y. (2023). Smarter Financial Life: Rethinking personal financial planning. *IBM Journal of Research and Development*, *58*(4), 10:11-10:10.

Attali, Y., & Arieli-Attali, M. (2015). Gamification in assessment: Do points affect test performance? *Computers & Education*, *83*, 57-63.

Auvinen, T., Hakulinen, L., & Malmi, L. (2019). Increasing Students' Awareness of Their Behavior in Online Learning Environments with Visualizations and Achievement Badges. *IEEE Transactions on Learning Technologies*, *8*(3), 261-273.

Badihi, S., & Heydarnoori, A. (2017). CrowdSummarizer: Automated Generation of Code Summaries for Java Programs through Crowdsourcing. *IEEE Software*, *34*(2), 71-80.

Baptista, G., & Oliveira, T. (2017). Why so serious? Gamification impact in the acceptance of mobile banking services. *Internet Research*, *27*(1), 118-139.

Barata, G., Gama, S., Jorge, J., & Gonçalves, D. (2016). Early Prediction of Student Profiles Based on Performance and Gaming Preferences. *IEEE Transactions on Learning Technologies*, *9*(3), 272-284.

Barratt, P. (2016). Healthy competition: A qualitative study investigating persuasive technologies and the gamification of cycling. *Health & Place*.

Bartle, R. (1996). Hearts, clubs, diamonds, spades: Players who suit MUDs. *Journal of MUD research*, *1*(1), 19.

Boyle, S. C., Earle, A. M., LaBrie, J. W., & Smith, D. J. (2017). PNF 2.0? Initial evidence that gamification can increase the efficacy of brief, web-based personalized normative feedback alcohol interventions. *Addictive Behaviors*, *67*, 8-17.

Buckley, P., & Doyle, E. (2017). Individualising gamification: An investigation of the impact of learning styles and personality traits on the efficacy of gamification using a prediction market. *Computers & Education, 106*, 43-55.

Bujari, A., Ciman, M., Gaggi, O., & Palazzi, C. E. (2022). Using gamification to discover cultural heritage locations from geo-tagged photos [journal article]. *Personal and ubiquitous computing*, *21*(2), 235-252.

Carlier, A., Salvador, A., Cabezas, F., Giro-i-Nieto, X., Charvillat, V., & Marques, O. (2019). Assessment of crowdsourcing and gamification loss in user-assisted object segmentation [journal article]. *Multimedia Tools and Applications*, *75*(23), 15901-15928.

Carrà, G., Crocamo, C., Bartoli, F., Carretta, D., Schivalocchi, A., Bebbington, P. E., & Clerici, M. (2019). Impact of a Mobile E-Health Intervention on Binge Drinking in Young People: The Digital–Alcohol Risk Alertness Notifying Network for Adolescents and Young Adults Project. *Journal of Adolescent Health*, *58*(5), 520-526.

Castellanos, S. (2016). Delivering modal-shift incentives by using gamification and smartphones: A field study example in Bogota, Colombia. *Case Studies on Transport Policy*, *4*(4), 269-278.

Christy, K. R., & Fox, J. (2022). Leaderboards in a virtual classroom: A test of stereotype threat and social comparison explanations for women's math performance. *Computers & Education*, *78*, 66-77.

Chung, A. E., Skinner, A. C., Hasty, S. E., & Perrin, E. M. (2018). Tweeting to health: a novel mHealth intervention using Fitbits and Twitter to foster healthy lifestyles. *Clinical Pediatrics*, *56*(1), 26-32.

Codish, D., & Ravid, G. (2022). Detecting playfulness in educational gamification through behavior patterns. *IBM Journal of Research and Development*, *59*(6), 6:1-6:14.

Coombes, E., & Jones, A. (2020). Gamification of active travel to school: A pilot evaluation of the Beat the Street physical activity intervention. *Health & Place*, *39*, 62-69.

Davis, K., & Singh, S. (2015). Digital badges in afterschool learning: Documenting the perspectives and experiences of students and educators. *Computers & Education*, *88*, 72-83.

de-Marcos, L., Domínguez, A., Saenz-de-Navarrete, J., & Pagés, C. (2024). An empirical study comparing gamification and social networking on e-learning. *Computers & Education*, *75*, 82-91.

de-Marcos, L., Garcia-Lopez, E., & Garcia-Cabot, A. (2019). On the effectiveness of game-like and social approaches in learning: Comparing educational gaming, gamification & social networking. *Computers & Education*, *95*, 99-113.

Deterding, S., Sicart, M., Nacke, L., O'Hara, K., & Dixon, D. (2011). Gamification. using game-design elements in non-gaming contexts. CHI'11 Extended Abstracts on Human Factors in Computing Systems,

El Tantawi, M., Sadaf, S., & AlHumaid, J. (2019). Using gamification to develop academic writing skills in dental undergraduate students. *European Journal of Dental Education*, n/a-n/a.

Filsecker, M., & Hickey, D. T. (2023). A multilevel analysis of the effects of external rewards on elementary students' motivation, engagement and learning in an educational game. *Computers & Education*, *75*, 136-148.

Gennari, R., Melonio, A., Raccanello, D., Brondino, M., Dodero, G., Pasini, M., & Torello, S. (2017). Children's emotions and quality of products in participatory game design. *International Journal of Human-Computer Studies*, *101*, 45-61.

González, C. S., Gómez, N., Navarro, V., Cairós, M., Quirce, C., Toledo, P., & Marrero-Gordillo, N. (2016). Learning healthy lifestyles through active videogames, motor games and the gamification of educational activities. *Computers in Human Behavior*, *55, Part A*, 529-551.

Hamari, J. (2023). Transforming homo economicus into homo ludens: A field experiment on gamification in a utilitarian peer-to-peer trading service. *Electronic Commerce Research and Applications*, *12*(4), 236-245.

Hamari, J., Koivisto, J., & Sarsa, H. (2018). Does gamification work?--a literature review of empirical studies on gamification. System Sciences (HICSS), 2014 47th Hawaii International Conference on,

Hamari, J., & Tuunanen, J. (2014). Player types: A meta-synthesis.

Hanus, M. D., & Fox, J. (2018). Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. *Computers & Education*, *80*, 152-161.

Hew, K. F., Huang, B., Chu, K. W. S., & Chiu, D. K. W. (2016). Engaging Asian students through game mechanics: Findings from two experiment studies. *Computers & Education*, *92–93*, 221-236.

Hwang, G.-J., Wu, P.-H., Chen, C.-C., & Tu, N.-T. (2016). Effects of an augmented reality-based educational game on students' learning achievements and attitudes in real-world observations. *Interactive Learning Environments*, *24*(8), 1895-1906.

Ibáñez, M. B., Á, D.-S., & Delgado-Kloos, C. (2021). Gamification for Engaging Computer Science Students in Learning Activities: A Case Study. *IEEE Transactions on Learning Technologies*, *7*(3), 291-301.

Jia, Y., Xu, B., Karanam, Y., & Voida, S. (2016). Personality-targeted gamification: a survey study on personality traits and motivational affordances. Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems,

Jin, L., Zhang, K., Lu, J., & Lin, Y.-R. (2020). Towards understanding the gamification upon users' scores in a location-based social network [journal article]. *Multimedia Tools and Applications*, *75*(15), 8895-8919.

Johansen, J. N., & Dintenfass, K. (2019). Real world gamification using augmented reality user devices. In: Google Patents.

Johnson, D., Horton, E., Mulcahy, R., & Foth, M. (2017). Gamification and serious games within the domain of domestic energy consumption: A systematic review. *Renewable and Sustainable Energy Reviews*, *73*, 249-264.

Jones, B. A., Madden, G. J., & Wengreen, H. J. (2023). The FIT Game: preliminary evaluation of a gamification approach to increasing fruit and vegetable consumption in school. *Preventive Medicine*, *68*, 76-79.

Kapp, K. M. (2012). *The gamification of learning and instruction: game-based methods and strategies for training and education*. John Wiley & Sons.

Koivisto, J., & Hamari, J. (2014). Demographic differences in perceived benefits from gamification. *Computers in Human Behavior*, *35*, 179-188.

Koivisto, J., & Hamari, J. (2019). The rise of motivational information systems: A review of gamification research. *International Journal of Information Management*, *45*, 191-210.

Kundisch, D., & von Rechenberg, T. (2016). Does the Framing of Progress Towards Virtual Rewards Matter? [journal article]. *Business & Information Systems Engineering*, 1-16.

Lin, D. T., Park, J., Liebert, C. A., & Lau, J. N. (2015). Validity evidence for Surgical Improvement of Clinical Knowledge Ops: a novel gaming platform to assess surgical decision making. *The American Journal of Surgery*, *209*(1), 79-85.

Magana, V. C., & Munoz-Organero, M. (2021). GAFU: Using a Gamification Tool to Save Fuel. *IEEE Intelligent Transportation Systems Magazine*, *7*(2), 58-70.

Marcon, M., Sarti, A., & Tubaro, S. (2016). Toothbrush motion analysis to help children learn proper tooth brushing. *Computer Vision and Image Understanding*, *148*, 34-45.

Marques, R., Gregório, J., Pinheiro, F., Póvoa, P., da Silva, M. M., & Lapão, L. V. (2019). How can information systems provide support to nurses' hand hygiene performance? Using gamification and indoor location to improve hand hygiene awareness and reduce hospital infections [journal article]. *BMC Medical Informatics and Decision Making*, *17*(1), 15.

Mavletova, A. (2022). Web surveys among children and adolescents: is there a gamification effect? *Social Science Computer Review*, *33*(3), 372-398.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2010). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *International Journal of Surgery*, *8*(5), 336-341.

Mokadam, N. A., Lee, R., Vaporciyan, A. A., Walker, J. D., Cerfolio, R. J., Hermsen, J. L., Baker, C. J., Mark, R., Aloia, L., Enter, D. H., Carpenter, A. J., Moon, M. R., Verrier, E. D., & Fann, J. I. (2018). Gamification in thoracic surgical education: Using competition to fuel performance. *The Journal of Thoracic and Cardiovascular Surgery*, *150*(5), 1052-1058.

Morschheuser, B., & Hamari, J. (2019). The gamification of work: Lessons from crowdsourcing. *Journal of Management Inquiry*, *28*(2), 145-148.

Nobel-Jørgensen, M., Malmgren-Hansen, D., Bærentzen, J. A., Sigmund, O., & Aage, N. (2016). Improving topology optimization intuition through games [journal article]. *Structural and Multidisciplinary Optimization*, *54*(4), 775-781.

Prandi, C., Roccetti, M., Salomoni, P., Nisi, V., & Nunes, N. J. (2022). Fighting exclusion: a multimedia mobile app with zombies and maps as a medium for civic engagement and design [journal article]. *Multimedia Tools and Applications*, *76*(4), 4951-4979.

Rapp, A., Cena, F., Gena, C., Marcengo, A., & Console, L. (2019). Using game mechanics for field evaluation of prototype social applications: a novel methodology. *Behaviour & Information Technology*, *35*(3), 184-195.

Ribeiro, N., Moreira, L., Barros, A., Almeida, A. M., & Santos-Silva, F. (2020). Guidelines for a cancer prevention smartphone application: A mixed-methods study. *International Journal of Medical Informatics*, *94*, 134-142.

Robson, K., Plangger, K., Kietzmann, J. H., McCarthy, I., & Pitt, L. (2015). Is it all a game? Understanding the principles of gamification. *Business Horizons*, *58*(4), 411-420.

Robson, K., Plangger, K., Kietzmann, J. H., McCarthy, I., & Pitt, L. (2016). Game on: Engaging customers and employees through gamification. *Business Horizons*, *59*(1), 29-36.

Rosani, A., Boato, G., & Natale, F. G. B. D. (2020). EventMask: A Game-Based Framework for Event-Saliency Identification in Images. *IEEE Transactions on Multimedia*, *17*(8), 1359-1371.

Sakamoto, M., Nakajima, T., & Akioka, S. (2016). Gamifying collective human behavior with gameful digital rhetoric [journal article]. *Multimedia Tools and Applications*, 1-43.

Su, C.-H. (2018). The effects of students' motivation, cognitive load and learning anxiety in gamification software engineering education: a structural equation modeling study [journal article]. *Multimedia Tools and Applications*, *75*(16), 10013-10036.

Suh, A., Cheung, C. M. K., Ahuja, M., & Wagner, C. (2019). Gamification in the Workplace: The Central Role of the Aesthetic Experience. *Journal of Management Information Systems*, *34*(1), 268-305.

Suh, A., Wagner, C., & Liu, L. (2016). Enhancing User Engagement through Gamification. *Journal of Computer Information Systems*, 1-10.

Tondello, G. F., Mora, A., & Nacke, L. E. (2017). Elements of gameful design emerging from user preferences. Proceedings of the Annual Symposium on Computer-Human Interaction in Play,

Vets, T., Nijs, L., Lesaffre, M., Moens, B., Bressan, F., Colpaert, P., Lambert, P., Van de Walle, R., & Leman, M. (2020). Gamified music improvisation with BilliArT: a multimodal installation with balls [journal article]. *Journal on Multimodal User Interfaces*, *11*(1), 25-38.

Wang, D. (2017). Gamified learning through unity 3D in visualizing environments [journal article]. *Neural Computing and Applications*, 1-6.

Wang, X., Goh, D. H.-L., Lim, E.-P., Wei Liang Vu, A., & Chua, A. Y. K. (2021). Examining the Effectiveness of Gamification in Human Computation. *International Journal of Human–Computer Interaction*, 1-9.

Werbach, K., & Hunter, D. (2022). *For the win: How game thinking can revolutionize your business*. Wharton Digital Press.

Zeybek, N., & Saygı, E. (2024). Gamification in education: Why, where, when, and how?—a systematic review. *Games and Culture*, *19*(2), 237-264.

Zuckerman, O., & Gal-Oz, A. (2014). Deconstructing gamification: evaluating the effectiveness of continuous measurement, virtual rewards, and social comparison for promoting physical activity [journal article]. *Personal and Ubiquitous Computing*, *18*(7), 1705-1719.

Bibliographic information of this paper for citing: