





## Exploring the Catalysts and Components of Gamification in Enterprise: A Systematic Literature Review



Rawaa Khalid AlTuraif<sup>1</sup>, Duha Sami AlSanad<sup>1</sup>, Nour Faisal AlSharifi<sup>2\*</sup>, Amnah Abdulateef Almuaili<sup>1</sup>

<sup>1</sup> IT Strategy & Technology Planning, Saudi Aramco, Dhahran 34481, Eastern, Saudi Arabia

<sup>2</sup> Technical Support Department, College of Health Sciences (The Public Authority for Applied Education and Training), Shuwaikh 23778, Kuwait

Corresponding Author Email: [nf.alsherifi@paaet.edu.kw](mailto:nf.alsherifi@paaet.edu.kw)

<https://doi.org/10.18280/isi.280418>

### ABSTRACT

**Received:** 24 April 2023

**Revised:** 20 July 2023

**Accepted:** 18 August 2023

**Available online:** 31 August 2023

#### Keywords:

*literature review, gamification, employee engagement, customer experience, gamification drivers, gamification elements*

This comprehensive review scrutinizes the body of literature on enterprise gamification from 2015 to 2023, drawing from databases such as Elsevier, IEEE, and Google Scholar. A corpus of 37 articles, bearing a close thematic affinity, were examined with an aim to discern the primary impetuses for gamification initiatives and to delineate the most prevalent elements across a broad spectrum of disciplines. It is underscored that gamification emerges as a multidisciplinary concept with far-reaching influence on an array of business operations, spanning marketing, customer engagement, management, health promotion, and software engineering, among others. The analysis discerns six primary categories of drivers prompting the adoption of gamification initiatives: enhancement of customer experience, bolstering employee engagement, process improvement, ensuring security and compliance, fostering organizational awareness and motivation, and promoting well-being. Employee engagement was recurrently cited, with objectives such as cultivating learning, augmenting engagement, and enhancing performance being predominantly highlighted. The findings also reveal an excess of 40 distinct gamification elements, with feedback mechanisms, points, badges, leaderboards, and progress bars being the most frequently employed. The review underlines the necessity of defining clear objectives and identifying pertinent stakeholders prior to the implementation of gamification strategies. Notwithstanding certain limitations, including the exclusion of particular types of publications and the potential oversight of relevant studies, this review furnishes insightful perspectives on the application of gamification in enterprises. Future research is encouraged to delve into the effects of less commonly utilized gamification elements.

## 1. INTRODUCTION

The historical continuum of games, from the earliest dice games of the ancient Egyptians and Greeks to the contemporary video games, underscores their integral role in human civilization. This enduring fascination has catalyzed the emergence of a novel phenomenon, termed as 'gamification', which incorporates game elements within non-game contexts [1]. Despite the term 'gamification' being coined in the early 2000s [2], the concept has been employed as a marketing strategy since the 1900s [3].

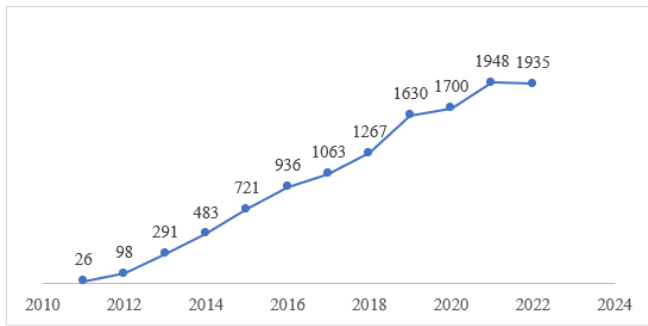
In the current digital epoch, gamification is harnessed to equip enterprises with a competitive edge [4]. Gartner posits that gamification renders work more enjoyable, engaging, and fulfilling, thereby augmenting productivity and enhancing the overall company culture [5]. It facilitates the adaptation to changes, amplifies business results, augments the efficacy of digital business strategies, and cultivates engagement [6].

Considering these manifold benefits, the ascendance of gamification as a major trend of the twenty-first century is unsurprising [7]. This burgeoning interest in gamification is mirrored in both scholarly and business arenas. For instance, a surge of over 70-fold was observed in the number of

gamification manuscripts indexed on the Scopus database, escalating from 26 in 2011 to 1935 in 2022 as depicted in Figure 1. Concurrently, the gamification market is projected to soar to \$95.5 billion by 2030 from \$9.9 billion in 2020 [8].

In order to stay abreast of this trend, this paper undertakes a review of studies on enterprise gamification, a specialized form of gamification that infuses game elements within a business setting to stimulate engagement, motivation, and productivity. This study seeks to respond to the research question: "What are the primary motivators and most frequently used elements in enterprise gamification initiatives across diverse fields?" It endeavors to augment the enterprise gamification literature by encapsulating the knowledge generated in this domain. This synopsis will empower researchers and professionals to accrue knowledge on this subject and thereby enhance their skills and expertise.

The ensuing sections of this paper are arranged as follows: the research methodology employed is explicated comprehensively, followed by a summary of the extant literature on enterprise gamification, providing valuable insights into the field. Subsequently, the principal results and limitations of the study are deliberated. The paper concludes with a synthesis of the findings from the literature.



**Figure 1.** Trend of academic studies on gamification

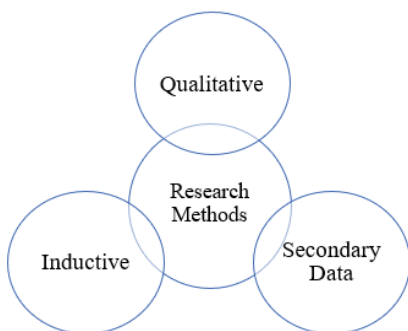
## 2. RESEARCH METHODS

The main purpose of this study is to provide a summary of the current literature related to the subject of enterprise gamification. To achieve this objective, a qualitative method was used to carry out an exhaustive, non-systematic review of the literature published between 2015 and 2023. The search was carried out through the following databases: Elsevier, the Institute of Electrical and Electronics Engineers (IEEE), and Google Scholar. The initial search resulted in identifying fifty (50) papers, thirteen (13) of which were excluded since they were not closely related to the area of study. Thus, the review focused on thirty-seven (37) articles.

The data extraction process involved a thorough reading and analysis of each article. Key information, such as the purpose of the study, the gamification elements used, and the outcomes, were extracted and recorded systematically. This data was then synthesized to identify common themes and trends across the literature.

Inductive reasoning was employed to identify themes across the selected literature. This process involved a detailed analysis of the data, noting patterns, similarities, and differences, and grouping these observations into broader themes. This was an iterative process, with themes being refined and redefined as more data was analyzed.

Eight (8) disciplines were identified within the context of enterprise gamification: Marketing & customer engagement, Human resources, Management, Performance management, Awareness campaigns, Health promotion, Software engineering, and Production environment. These disciplines were chosen based on their relevance to the topic of study, as evidenced by the frequency of their occurrence in the literature. Each discipline represents a unique context in which gamification is applied, thus providing a comprehensive overview of the field.



**Figure 2.** Research methods

Figure 2 below summarizes the methods adopted to conduct this research. As mentioned previously, this is a qualitative study that depends on secondary data. Inductive reasoning was used to identify the themes across selected literature.

## 3. LITERATURE REVIEW

As stated previously, this paper provides an overview of how gamification can be applied in organizations exploring the concept of gamification and its application in various organizational contexts. Several databases were used to conduct the search including Elsevier, IEEE, and Google Scholar. The search for literature on enterprise gamification resulted in around 50 papers, which have been reduced to 37 papers that are closely related to the area of study. In this section, the selected papers have been categorized into eight (7) different categories that correspond to the use cases associated with enterprise gamification. This categorization facilitates the discussion of the various use cases in a structured manner.

### 3.1 Marketing and customer engagement

With the rise of digitization in business, gamification has emerged as a significant tool that affects marketing strategies and customer engagement. For instance, Raj and Gupta [9] followed a cross-sectional descriptive research design to examine the impact of gamification on e-commerce websites and customer loyalty. Three gamification elements were analyzed in this study, these were interface design, social influence, and rewards. The study showed that the examined gamification elements had a positive impact on attitudes toward gamification and brand loyalty.

Another notable study is Hajarian and Hemmati's [10] which developed a word-of-mouth recommendation system that applied gamification techniques. The system was deployed on an e-commerce website, which led to an increase in the average number of visits for both males and females by 100% and 116%, respectively.

Moreover, Jayasooriya et al. [11] aimed to study the effect of applying gamification in retail marketing. They conducted a detailed review of the literature and carried out interviews with marketing professionals to define the trends, drivers, and challenges of applying gamification. The study found that achieving marketing KPIs, improving customer experience, and getting customer recommendations were the main drivers of utilizing gamification. In addition, customers were interviewed to gather design preferences for gamified applications. The respondents' feedback mainly focused on the game mechanics and ease of information accessibility.

Additionally, Permana et al. [12] conducted a study to analyze how gamification affects brand engagement and awareness in online marketplaces using a survey with a sample size of 484 individuals. Three categories of gamification features were considered, these are immersion (e.g., personal avatars, account personalization), achievement (e.g., badges, leaderboards), and social interaction (e.g., competitions, feedback). The paper examined the impact of each feature on the cognitive, social, emotional, affective, and behavioral dimensions. The results of this study highlighted that not all gamification features can influence brand engagement. It was established that immersion features have an impact on the behavioral, cognitive, and social dimensions. Achievement

features, on the other hand, impact all dimensions (behavioral, cognitive, affective, emotional, and social). Lastly, social features can impact the social and cognitive dimensions.

Finally, Raflesia and Surendro [13] proposed a gamified-service prototype to aid an organization in creating a game-like working environment. The prototype uses a points-based system to gamify and monitor the roles of Information Technology Infrastructure Library (ITIL) such as Service Desk Analyst (SDA). The gamified solution enabled the analysts to earn points for closing tasks successfully. It also provided insights into the weaknesses of the services provided by the IT group by recording and reporting the frequently reported tasks. These features assisted in creating a competitive and fun environment.

Therefore, such studies provide an overview and create awareness to the effectiveness of the vital role gamification plays in both marketing and customer engagement.

### 3.2 Human resources

By recognizing the significant use of gamification in marketing and customer engagement, this section highlights the potential of gamification in human resources. Mostafa and Elbarawy [14] demonstrated that the utilization of gamification tools, such as leaderboards, badges, and points proves to be highly effective in achieving the objectives of job matching model. The developed model applies gamification tools with the purpose of improving candidate learning and career paths. The model had five modules, to (a) recognize the applicant's skills, (b) match the applicant with a national program, (c) set the applicant's learning path, (d) improve the learning path, and (e) provide the applicant with the job that got the highest similarity.

In another study aiming to improve employees' well-being through building a cloud-based gamified team-building application by Barna and Fodor [15] revealed that 71% of participants experienced a change in environment, having an easier and more fun atmosphere. The application allowed the staff to obtain points by taking part in different events, the more individuals participating, the more points obtained.

Fauziyah et al. [16] proposed a platform for employee training that applies gamification techniques for a bank in Indonesia. The platform contained an animated character to recommend courses and provides hints, badges, leaderboard. Additionally, the platform allowed learners to switch their points and badges for rewards like a day off. The implementation of this platform improved the learning process for employees and achieved positive results compared to the traditional E-learning systems.

Ulmer et al. [17] developed a gamified Virtual Reality (VR) environment for employee training specific to the manufacturing industry. The environment was linked to Key Performance Indicators (KPIs) to measure the trainee's performance and generate points accordingly. This environment provided a learning pace that is suitable for the learner's background and dynamics. Moreover, the evaluation system enabled adaptive work sequences.

In addition, Wang et al. [18] surveyed training specialists to identify the key components of effective gamification in the corporate training environment. According to the specialists, the focus areas included (a) incorporation of gamification with the learning program, (b) providing immediate feedback on desirable behaviors, (c) establishing a team-oriented competition mechanism, and (c) developing level-based tasks

that increase in difficulty in a limited time frame. Also, the specialists highlighted the importance of points and leaderboards as effective scoring components.

In conclusion, the application of gamification in the field Human Resources has shown significant potential in enhancing various HR processes. However, the successful implementation of gamification in HR requires careful planning, alignment with business goals and strategic integration with business processes.

### 3.3 Management

The use of gamification in management is seen as a strategic approach to align works with broader organizational goals, foster participation and facilitate the adoption of new technologies. Thus, research and cases are explored to present the application of gamification in management. Stanculescu et al. [19] proposed an enterprise gamification framework that is integrated with existing web systems to measure the effect of gamification in achieving social interaction and learning. The study was conducted on 206 employees of a multinational organization known as IBM. The authors of the study developed a web application named "How much of an IBMer are you" (HMIAY) which applies gamification techniques such as leader boards and badges. The application fostered employees' engagement through a Q&A web application integrated with learning, news sharing, and social connections modules.

Hussain et al. [20] studied the impact of gamification on employee retention, motivation, and loyalty. The experiment consisted of 142 participants who were divided into two groups. The control group was given tasks without applying gamification, while the test group was given the same tasks but in a gamified environment, which used gamification mechanics such as leaderboards, prizes, and badges. At the end of the experiment, the test group showed significantly better results in terms of retention, motivation, and loyalty.

On the other hand, Ruhi [6] presented some insights on the key success elements to adopt enterprise gamification to improve performance at the employee and organization levels. The results of their investigation discovered that carefully planning gamification initiatives and rationalizing game elements were crucial for successful adoption. Important aspects to consider when applying gamification are: alignment of gamification initiatives with business goals, strategic integration of gamification with business processes, collaboration with experts, and close monitoring of the entire process.

The findings suggest how gamification can drive employee engagement, enhance performance, and foster a culture of continuous learning and improvement.

### 3.4 Performance management

The concepts of management and performance management work together to align individual efforts with organizational objectives. Recognizing the significance of this relationship it became crucial to explore the use of gamification in performance management. Therefore, this section helps understand the diverse aspects and potential benefits of gamification within this context. For instance, Cacaïs and Sales [21] developed a system that incorporated gamification elements for performance evaluation and tasks monitoring. The system featured a user-friendly interface that helped users

to concentrate better, and a point-based ranking system to motivate staff to complete more tasks. This system facilitates corporate evaluation and promotes e collaboration among group members.

On the other hand, Ponis et al. [22] conducted a survey among supervisors and pickers in several distribution centers to explore the acceptance of applying Augmented Reality (AR), gamification, or gamified AR in the picking process. The results suggested that the combination of gamification and AR was the most desired option, as 66% of the participants believed that gamified AR solutions were the most suitable and effective for everyday tasks. Hosseini et al. [23] examined the impact of gamification on two user groups, the test group and control group, utilizing an application designed to promote healthy habits during Covid-19. The test group, used a gamified version of the application with mechanics such as progress bars and leaderboards, outperformed the control group that used a non-gamified application, in terms of deliverables' quality.

Another study, provide steps that assists the organization in applying gamification to its business processes. The study carried by Najjar et al. [24] presents the lifecycle of gamified business process management, consisting of 8 steps. These steps included analyzing the process, selecting appropriate players, identifying goals and objectives, understanding human motivation, determining game mechanisms, designing the gamified process, executing it, and managing, monitoring, and analyzing the entire process.

Furthermore, Swacha [25] investigated the application of gamification mechanics in Enterprise Information Systems (EIS). Various use cases were examined to identify their possible impact on employee performance. Such as, marking critical tasks as 'final boss fight' to better prepare employees for challenges and defining penalties for uncompleted. The findings indicated that incorporating gamification mechanics had a positive impact on overall staff performance.

In conclusion, the studies highlighted provide compelling results shows the significant role gamification in performance management whether in driving employee engagement, enhancing task completion and/or improving overall organizational performance.

### 3.5 Awareness campaigns

Awareness campaigns are a critical tool for disseminating information and promoting behavioral changes in various fields. Gamification, with its engaging mechanics and immersive elements, has the potential to enhance the effectiveness of these campaigns making them more engaging and impactful. In this paper, a particular focus on cybersecurity and health promotions literature is argued.

#### 3.5.1 Cybersecurity awareness

Baxter et al. [26] conducted a study on the impact of gamification in Information Technology security, involving 850 participants with different levels of gaming experience. The experiment suggested that participants with less gaming experience enjoyed the gamified training more than those with gaming experience. This indicates that utilizing gamified training equally increased knowledge acquisition among both groups.

In a different study, Alami and Dalpiaz [27] proposed a gamified platform for STS-ml language and security training. The platform received positive feedback on usability and

engagement. Using several gamification tools were used in this platform including avatars, animated feedback, leaderboards, and conformity anchor. The gamified platform increased the number of participants in the training program.

Additionally, virtual escape room designed by DeCusatis et al. [28] designed to train individuals on cybersecurity fundamentals such as cryptography and phishing scams. The system was built to improve user engagement and knowledge retention, receiving positive results in empowerment, avoidance, and accomplishment metrics after being tests on 120 participants.

Broholm et al. [29] studied gaming elements that can improve user motivation in cybersecurity learning platforms through focus group interviews. The top-picked elements by the groups included were customizable avatars, badges, and challenges based on a storyline or a theme.

Finally, Ashely et al. [30] introduced a gamified system for cybersecurity training based on network security frameworks. The system simulated realistic cyberattacks for the purpose of training employees in specific cybersecurity workforce roles. Inside the game, the players were provided with a variety of defensive strategies based on the National Institute of Standards and Technology (NIST) cybersecurity framework.

#### 3.5.2 Health promotion

The literature findings have indicated that Gamification plays a vital role in health promotion and serves as a significant tool that can be utilized in awareness campaigns. For instance, Pratikto et al. [31] presented a mobile application to encourage users to exercise regularly and to lead a healthier lifestyle with the help of gamification. The application followed a user-centered approach. The feedback collected from the users indicated that the gamified application was enjoyable and useful. Additionally, Setiawan and Suryadibrata [32] developed a mobile application to encourage maintaining a healthy lifestyle. The application obtained users' data such as step counts and heart rates from their smartwatches and implemented a specific gamification framework to maintain user engagement. The results of the study depicted that 74.59% of users felt immersed in using the application and 81.43% reported that they will continue to use it in the future.

These examples highlight the potential of gamification in health promotion, demonstrating its ability to engage users, motivate behavior change, and ultimately contribute to improved health outcomes.

### 3.6 Software engineering

In the field of software engineering, gamification has been also effectively utilized to enhance productivity and engagement. For example, Straubinger and Fraser [33] proposed a tool that applied gamification to improve the software testing process. The game elements were built based on commits to the repository of the source code. Software engineers, either individually or in teams, were able to compete by completing the challenges to earn points and move up on the leaderboard. After testing the tool on a software development company, the evaluation yielded positive results, as project coverage increased by 7% and the number of tests increased by 20%.

Also, different gamification elements such as badges, challenges, and leaderboards were used to engage developers. In a study by Sisomboon et al. [34], a gamified Scrum approach was presented for software engineers. The study

consisted of 75 participants divided into 10 groups that were closely monitored to measure their behavioral changes.

Marques et al. [35] proposed a gamified JIRA add-on to help in increasing developers' motivation to adopt Scrum in software development. The add-on was built based on the 6D gamification framework to formalize gamification adoption. Different gamification elements were used to engage the developers such as scoring systems. In addition, big achievements were awarded with points, badges, and gems which can be traded later for special prizes.

Pedreira et al. [36] built a gamification engine for a software development company to help in creating a gamified work environment through the integration of custom-developed and commercial off the shelf tools such as JUnit and Redmine. The solution allowed the organization to combine all the rewards of different tools in a centralized environment and to keep its current tools with minimum modifications.

In another study, Cuevas-Martínez et al. [37] conducted a four-year experiment to maintain students' motivation in information technology engineering. In their experiment, the authors built an application for students' assessment that was similar to the video game, Super Mario. The overall results state that the usage of the gamified application had indeed raised motivation and improved learning outcomes as most participants obtained good grades and reached high task-completion rates.

On the other hand, Moldon et al. [38] studied the impact of gamification by examining the changes in developers' behavior when GitHub, a collaborative hosting service for software development and version control, removed the gamification elements from the platform. The removal of the gamified features was followed by a notable change in behavior. Logging events such as long-running streaks, weekend activities, and synchronizing streaking behavior in the platform's social network all decreased. This suggests how gamification significantly impacts practice in the software development context.

Whereas, Vertash et al. [39] proposed an approach to apply gamification to the agile processes within a game development company. In this approach, the workplace was gamified. Gamification elements such as badges and points were awarded for different achievements which were later exchanged for prizes. The results showed that sprint velocity improved by an average of 50% after gamification adoption as well as employee productivity and loyalty.

In conclusion, the positive results shown in various studies of applying gamification to software engineering, indicating its potential to enhance developer engagement, productivity, and motivation.

### 3.7 Production environment

The application of gamification in product environments has been explored in various studies as shown below, demonstrating its potential to enhance worker engagement and acceptance of new technologies. As evidence, Remi-Omosowon et al. [40] developed a gamified container loading system to assist operatives to load containers. Before applying gamification, the system faced resistance from the workers since they felt it can be used as their replacement. The results showed that introducing gamification into the system facilitated the acceptance by the workers. The gamified version of the system offered an interactive and simple environment which in turn increased engagement and

acceptance.

Furthermore, Cunha Leite et al. [41] introduced a Gamified Construction Project System, a web tool that used gamification to enhance the transparency of production assignments and improve workers' motivation and performance. The tool incorporated several game elements such as badges, point systems, leaderboards, and feedback. Their research indicated that the tool was successful in increasing transparency in communicating weekly tasks assignments and policies.

In another example, Liu et al. [42] developed a mobile application based on a gamified job-design framework. Three job aspects were chosen to gamify, which are skill variation, autonomy, and feedback. The gamification elements that were used in this solution were points, badges, achievements, leaderboards, and competitions. To test the impact of the application, 60 machine operators were selected. The results suggested that the application had a notable impact on job motivation and satisfaction.

Finally, Tsourma et al. [43] aimed to encourage workers to participate in knowledge-sharing activities in Industry 4.0 industrial environments. To accomplish their goal, they developed a web-based social media platform that utilized gamification mechanics and a gamification engine. The platform included several features such as a user-friendly interface, badges, and AR. The solution helped in solving common issues in the industry like insufficient worker training and inadequate experience.

These examples illustrate the effect of gamification in enhancing production environment, improving worker engagement, and facilitating the adoption of new technologies.

The literature reviewed in this section reflects the breadth of contexts, from marketing to production, the review highlights the versatile applicability of gamification across the organizational landscape. Fundamentally, gamification provides a toolkit to motivate target behaviors in each setting. Marketing campaigns aim to drive customer engagement; human resources seek to enhance employee performance; management needs to align workers with broader goals; production environments require participation and adoption of new technologies. Gamification offers scientifically-grounded techniques to incentivize and stimulate the desired actions to achieve key objectives in all these spheres. Furthermore, benefits surface even in non-commercial domains like health promotion and cybersecurity awareness where gamification fosters vital but often tedious practices. The diversity of applications underscores the adaptability of gamification and suggests there may be a few areas where its basic principles and mechanics cannot be leveraged, especially within enterprises. The collective insights provide a persuasive case for the versatility of gamification across the organizational landscape.

## 4. FINDINGS

In this section, we present the insights assembled from the comprehensive analysis of the selected literature. The findings can be organized into three primary subsections, these are as follows: (a) an overarching summary of the conducted review; (b) a detailed examination that highlights the key drivers motivating enterprises to engage in gamification initiatives; and (c) a focused summary that concentrated on the specific gamification elements utilized within these projects, offering a comprehensive overview of the techniques and tools

employed across different contexts.

By structuring our findings in this manner, we aim to provide a thorough understanding of the current state of enterprise gamification research. This enables readers to grasp not only the general themes and trends in the literature but also the underlying motivations and essential elements that contribute to the successful implementation of gamification initiatives.

#### 4.1 Summary of conducted review

A trend toward the use of gamification in various disciplines, including marketing, human resources, management, and software engineering was observed in the reviewed literature. The review revealed over 40 unique gamification components, with feedback, points, badges, leaderboards, and progress bars being the most commonly utilized. This trend suggests a growing recognition of the benefits of gamification in enhancing engagement, motivation, and productivity in enterprises.

The detailed examination of the key drivers revealed that enterprises are motivated to engage in gamification initiatives for various reasons. These include enhancing customer experience, boosting employee engagement and development, improving process efficiency, and promoting organizational awareness and motivation. However, there were contradictions in the literature regarding the effectiveness of gamification in achieving these objectives, indicating a need for further research in this area.

The focused summary on the specific gamification elements utilized within these projects highlighted that while some elements like feedback, points, badges, leaderboards, and progress bars are commonly used, others like ratings, voting, and rankings are less frequently mentioned. This suggests that while certain gamification elements are widely recognized for their effectiveness, others may be underutilized or their potential benefits not fully understood.

In conclusion, the findings from this review highlight the diverse applications and benefits of gamification in enterprises. However, they also underscore the need for further research to fully understand the potential of less commonly used gamification elements and to resolve contradictions in the literature regarding the effectiveness of gamification in achieving various objectives.

Table A1, which can be found in the appendix, depicts a summary of the articles that were reviewed for this study. It can be noticed that gamification is a multi-disciplinary tool, it has been applied in fields such as marketing, human resources, management, performance management, awareness campaigns, health promotion, software engineering, and production environment. When used for marketing and customer engagement, gamification elements positively impact attitudes toward gamification and brand loyalty. In human resources, gamification is mainly applied online and can improve employee well-being, training, and learning. In performance management, gamification and augmented reality are the most desired options for improving motivation and collaboration. In awareness campaigns, gamification can encourage healthy lifestyles and cybersecurity awareness. In software engineering, gamification can increase motivation and productivity in software development processes. Lastly, in protection environments, gamification can enhance job motivation and satisfaction, and knowledge sharing in industrial environments. These studies suggest that

gamification can have a positive impact on various fields and can be an effective tool for achieving different objectives.

#### 4.2 Drivers for engaging in gamification projects

The importance of Gamification is highlighted by its competitive nature, which has a direct impact on both the speed and quality of performance. Furthermore, a greater volume of data is effectively absorbed and with a better memory retention [44]. The positive impacts of gamification across various fields and objectives are well-documented in the reviewed literature. For instance, Baxter et al. [26] studied the impact of gamification on Information Technology security awareness among 850 participants, finding that those with less gaming experience enjoyed the gamified training more, indicating its potential for broad appeal. In the realm of marketing, Jayasooriya et al. [11] found that gamification was instrumental in achieving marketing KPIs, improving customer experience, and garnering customer recommendations.

In the context of human resources, Mostafa and Elbarawy [14] developed a job-matching model that applied gamification tools, which improved candidate learning and career paths. Furthermore, Stanculescu et al. [19] proposed an enterprise gamification framework that was integrated with existing web systems to measure the effect of gamification in achieving social interaction and learning. The study was conducted on 206 employees of a multinational organization known as IBM, further demonstrating the wide applicability of gamification.

Swacha [25] applied gamification mechanics in Enterprise Information Systems (EIS) to examine their impact on employee performance. For instance, marking critical tasks as ‘final boss fight’ was used to better prepare employees for challenges. Barna and Fodor [15] built a cloud-based gamified team-building application to improve employees’ well-being. The application allowed staff to earn points by participating in different events, creating a more fun and engaging work environment.

Fauziyah et al. [16] proposed a gamified platform for employee training for a bank in Indonesia. The platform used an animated character to recommend courses and provide hints, badges, and leaderboards. It also allowed learners to exchange their points and badges for rewards like a day off, improving the learning process for employees. Liu et al. [42] developed a mobile application based on a gamified job-design framework. The application used points, badges, achievements, leaderboards, and competitions to increase job motivation and satisfaction among machine operators.

Finally, Pedreira et al. [36] built a gamification engine for a software development company to create a gamified work environment. The solution allowed the organization to combine all the rewards of different tools in a centralized environment, increasing motivation and productivity. These examples underscore the versatility and effectiveness of gamification in achieving diverse objectives across various fields.

Conversely, Table A2, which can be found in the appendix showcases the diverse drivers behind engaging in enterprise gamification activities, as identified from the analyzed literature. It consolidates the motives along with their associated disciplines and studies. These motivators can be classified into six overarching categories. First, Customer Experience, a direct or indirect subjective response that a

customer experiences while interacting with a company [45]. Second, Employee Engagement & Development as defined by Eldor and Harpaz [46] “A proactive and motivated state where individuals enthusiastically invest their physical, emotional, and cognitive resources into their work”. Third, Process Improvement & Efficiency, a method aimed to facilitating the systematic changes in a current process or the creation of a new one [47]. Fourth, Security & Compliance, is the “users’ adherence to established security standards and regulations when accessing and utilizing IT assets and services” [48]. Fifth, Organizational Awareness Motivation is a thorough understanding of the organization's strategy, awareness of shared challenges faced by various groups within the organization, a collective view on the recognition of the need for change, and acknowledgment of the different roles that exist within the broader organizational context [49]. The sixth and final category is Well-being. Well-being in the context of health promotion and gamification refers to the involvement of positive affect.

An alternative summary of the studies is presented in Table A3, which provides an overview from the standpoint of gamification elements. The table displays each element in conjunction with the corresponding study and discipline. The literature highlights more than 40 distinct gamification elements. Feedback, points, badges, leaderboards, and progress bars emerged as the most frequently employed components in the gamification initiatives of the examined studies. Components such as rating, voting, ranking, and voting were the least mentioned in the reviewed literature.

## 5. RESEARCH LIMITATIONS

A few limitations to this paper should be noted. Firstly, the reviewed literature was selected following an un-systematic approach, this may have led to the elimination of relevant studies. However, this approach was chosen to focus on the most impactful and recent studies in the field of enterprise gamification.

Secondly, only conference and journal articles were reviewed, other types of publications, such as books, letters, book chapters, and government reports were not included. This decision was made based on the premise that conference and journal articles typically undergo rigorous peer-review processes, ensuring the credibility and quality of the information. However, this focus might introduce a potential bias as it overlooks the insights and perspectives offered in other types of publications.

Furthermore, the review was restricted to articles generated between 2015 and 2023. Therefore, any relevant studies published before this time frame were excluded from this paper. Consequently, some developments or trends in the area of enterprise gamification may have been missed.

In terms of analysis, the study primarily employed qualitative methods and inductive reasoning to identify themes across the selected literature. While this approach allowed for a comprehensive understanding of the current state of enterprise gamification research, it may have limited the ability to make broad generalizations or identify causal relationships.

Yet, regardless of the aforementioned limitations, this review paper provides valuable insights into enterprise gamification in numerous contexts.

## 6. CONCLUSION

### 6.1 Summary of conclusions

The research question that this comprehensive review paper aims to answer is: What are the primary motivators for enterprise gamification initiatives and what are the most frequently used elements across diverse fields? The study seeks to answer this question by conducting a comprehensive review of literature published from 2015 to 2023, focusing on 37 related articles. The research emphasizes the importance of defining clear objectives and identifying stakeholders before implementing gamification strategies. The study also explores the benefits of gamification in enterprises, such as increased engagement, motivation, and productivity, and suggests areas for future research.

The review revealed that enterprise gamification is a multi-disciplinary concept with eight key disciplines including marketing and customer engagement, human resources, management, performance management, awareness campaigns, health promotion, software engineering, and production environment. Within each discipline, gamification has a unique impact on different aspects of business operations.

In marketing and customer engagement, gamification elements have been found to increase brand loyalty, engagement, and competition, while also helping to achieve marketing KPIs and improving customer experience. According to the reviewed literature, the most widely used gamification elements for marketing and customer engagement include interface design, social influence, and rewards.

Within the human resources context, gamification has been found to improve employee well-being, make learning more enjoyable, and assist with planning career paths.

When literature on enterprise gamification is examined from a management point of view, it has been found that gamification helps to foster employee engagement, retention, motivation, and loyalty. It is important to note that there are some important aspects that need to be considered when adopting gamification in the management setting, these include alignment with business objectives, integration with business processes, collaboration among experts, and close monitoring of the full process.

In performance management, gamification supports organizations with corporate evaluation and promotes collaboration among group members. The studies depict that combining gamification with AR is the most desired option in the performance management field.

For cybersecurity awareness, gamified platforms increase the usability of solutions and engagement among individuals. Customizable avatars, badges, and challenges based on a storyline or a theme are popular gamified elements.

For health promotion, gamified apps encourage users to maintain a healthy lifestyle and create an immersive experience.

In the software engineering field, gamification has been used to engage and motivate software engineers, leading to enhanced sprint velocity, productivity, and loyalty. Scoring systems, points, badges, and gems are some of the popular gamification elements in this field.

Finally, within the production environment context, gamified systems offer an interactive and simple environment that increases engagement and transparency. This in turn leads to raising job motivation and satisfaction. Badges, point



systems, leaderboards, and feedback are commonly used gamification elements in the production environment field.

Upon further analysis of the literature, the primary motives for engaging in gamification initiatives were identified. These drivers can be broadly classified into six categories: Customer Experience, Employee Engagement & Development, Process & Efficiency Improvement, Security & Compliance, Organizational Awareness & Motivation, and Well-being. Notably, employee engagement emerged as the most frequently cited category among the investigated studies, encompassing objectives such as promoting learning, enhancing engagement, and bolstering performance.

Additionally, the studies were scrutinized from the standpoint of gamification elements. The literature revealed more than 40 unique gamification components. It was determined that feedback, points, badges, leaderboards, and progress bars are the most commonly utilized elements in the gamification initiatives of the reviewed studies. In contrast, components like ratings, voting, rankings, and voting were the least mentioned in the examined literature.

In conclusion, gamification is a powerful tool that can yield myriad benefits when applied effectively. To fully realize its potential, it is crucial to establish the objectives, stakeholders, and mechanisms of the gamification project prior to implementation.

## 6.2 Limitations and future work directions

While this review provides valuable insights into enterprise gamification, it is not without limitations. The study focused on articles published between 2015 and 2023, excluding potentially relevant studies published outside this timeframe. Additionally, the review was limited to articles sourced from specific databases, potentially overlooking relevant studies published elsewhere. Furthermore, the review was conducted in a non-systematic manner, which may have led to the omission of pertinent studies. Future research could address these limitations by conducting a more comprehensive, systematic review of the literature, including studies published outside the specified timeframe and sourced from a wider range of databases. Additionally, future research could delve into the effects of less commonly used gamification elements, which were not extensively covered in this review.

## 6.3 Practical implications

The findings of this review have several practical implications for organizations interested in implementing gamification initiatives. Firstly, it is crucial for organizations to establish clear objectives and identify relevant stakeholders prior to implementation. This will ensure that the gamification initiative aligns with the organization's business goals and is integrated with its business processes. Secondly, organizations should consider collaborating with experts and closely monitoring the entire process to ensure successful adoption. Thirdly, organizations should consider the unique impact of gamification within their specific discipline, as gamification has been found to have different effects across various fields such as marketing, human resources, management, and performance management. Lastly, organizations should consider utilizing the most commonly used gamification elements identified in this review, such as feedback, points, badges, leaderboards, and progress bars, while also exploring the potential benefits of less commonly used elements.

## REFERENCES

- [1] Deterding, S., Dixon, D., Khaled, R., Nacke, L. (2011). From game design elements to gamefulness: defining "gamification". In Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments, NY, USA, pp. 9-15. <https://doi.org/10.1145/2181037.2181040>
- [2] Marczewski, A. (2013). Gamification: a simple introduction. Andrzej Marczewski. [https://books.google.com.sa/books?hl=en&lr=&id=IOu9kPjIhdYC&oi=fnd&pg=PA3&dq=Gamification:+a+simple+introduction.&ots=kJRqWffMWZ&sig=zLflrAiI BriWSuVR15N4IAu\\_98g&redir\\_esc=y#v=onepage&q=Gamification%3A%20a%20simple%20introduction.&f=false](https://books.google.com.sa/books?hl=en&lr=&id=IOu9kPjIhdYC&oi=fnd&pg=PA3&dq=Gamification:+a+simple+introduction.&ots=kJRqWffMWZ&sig=zLflrAiI BriWSuVR15N4IAu_98g&redir_esc=y#v=onepage&q=Gamification%3A%20a%20simple%20introduction.&f=false), accessed Sep. 5, 2023.
- [3] Simpson, P., Jenkins, P. (2015). Gamification and Human Resources: an overview. Brighton: Brighton Business School, 1-6.
- [4] Aziz, A., Mushtaq, A., Anwar, M. (2017). Usage of gamification in enterprise: A review. In 2017 international conference on communication, computing and digital systems (C-CODE), Islamabad, Pakistan, pp. 249-252. <https://doi.org/10.1109/C-CODE.2017.7918937>
- [5] Hype Cycle for Digital Government Services. (2022). Gartner. Available: <https://www.gartner.com/en/webinars/4016921>, accessed Sep. 06, 2023
- [6] Ruhi, U. (2016). Level up your strategy: Towards a descriptive framework for meaningful enterprise gamification. arXiv preprint arXiv:1605.09678. <https://doi.org/10.48550/arXiv.1605.09678>
- [7] Oliver, E. (2017). Gamification as transformative assessment in higher education. HTS: Theological Studies, 73(3): 1-15. <https://doi.org/10.4102/hts.v73i3.4527>
- [8] Gamification market (by component: Solution, service; by deployment model: On premise, cloud; by Enterprise Size: Large Enterprises, SMEs; by application: Sales & Marketing, product development, human resource, support, others; by industry vertical: Retail, education, it and Telecom, BFSI, manufacturing, media and entertainment, other) - global industry analysis, size, share, growth, trends, regional outlook, and forecast 2022-2030," Precedence Research. Available: <https://www.precedenceresearch.com/gamification-market>. accessed Sep. 06, 2023
- [9] Raj, B., Gupta, D. (2018). Factors influencing consumer responses to marketing gamification. In 2018 International Conference on Advances in Computing, Communications and Informatics (ICACCI), Bangalore, India, pp. 1538-1542. <https://doi.org/10.1109/ICACCI.2018.8554922>
- [10] Hajarian, M., Hemmati, S. (2020). A gamified word of mouth recommendation system for increasing customer purchase. In Proceeding of 4th International Conference on Smart Cities, Internet of Things and Applications, SCIoT, Mashhad, Iran. <https://doi.org/10.1109/SCIoT50840.2020.9250209>
- [11] Jayasooriya, S., Alles, T., Thelijagoda, S. (2020). Demystifying the concept of IoT enabled gamification in retail marketing: An exploratory study. In 2020 International Research Conference on Smart Computing



- and Systems Engineering (SCSE), Colombo, Sri Lanka, pp. 234-241. <https://doi.org/10.1109/SCSE49731.2020.9313039>
- [12] Permana, F.H., Handayani, P.W., Pinem, A.A. (2021). The influence of gamification on brand engagement and brand awareness in online marketplaces. In 2021 International Conference on Advanced Computer Science and Information Systems (ICACSIS), Depok, Indonesia, pp. 1-6. <https://doi.org/10.1109/ICACSIS53237.2021.9631349>
- [13] Raflesia, S.P., Surendro, K. (2015). Designing gamified-service towards user engagement and service quality improvement. In 2015 1st International Conference on Wireless and Telematics (ICWT), Manado, Indonesia, pp. 1-4. <https://doi.org/10.1109/TSSA.2015.7440439>
- [14] Mostafa, L., Elbarawy, A.M. (2018). Enhance job candidate learning path using gamification. In 2018 28th International Conference on Computer Theory and Applications (ICCTA), Alexandria, Egypt, pp. 88-93. <https://doi.org/10.1109/ICCTA45985.2018.9499189>
- [15] Barna, B., Fodor, S. (2018). Gamification's impact on employee engagement: Enhancing employee well-being with a cloud based gamified team-building application. In 2018 6th International Conference on Future Internet of Things and Cloud Workshops (FiCloudW), Barcelona, Spain, pp. 203-208. <https://doi.org/10.1109/W-FiCloud.2018.00039>
- [16] Fauziyah, U., Kaburuan, E.R., Wang, G. (2019). Gamification for employee training platform in banking industries. In 2019 International Conference on Information Management and Technology (ICIMTech), Jakarta/Bali, Indonesia, Vol. 1, pp. 503-508. <https://doi.org/10.1109/ICIMTech.2019.8843750>
- [17] Ulmer, J., Braun, S., Cheng, C.T., Dowey, S., Wollert, J. (2020). Gamified virtual reality training environment for the manufacturing industry. In 2020 19th International Conference on Mechatronics-Mechatronika (ME), Prague, Czech Republic, pp. 1-6. <https://doi.org/10.1109/ME49197.2020.9286661>
- [18] Wang, Y.F., Hsu, Y.F., Fang, K. (2022). The key elements of gamification in corporate training—The Delphi method. *Entertainment Computing*, 40: 100463. <https://doi.org/10.1016/j.entcom.2021.100463>
- [19] Stanculescu, L.C., Bozzon, A., Sips, R.J., Houben, G.J. (2016). Work and play: An experiment in enterprise gamification. In Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing (pp. 346-358). <https://doi.org/10.1145/2818048.2820061>
- [20] Hussain, S., Qazi, S., Ahmed, R.R., Streimikiene, D., Vveinhardt, J. (2018). Employees management: Evidence from gamification techniques. *Montenegrin Journal of Economics*, 14(4): 97-107. <https://doi.org/10.14254/1800-5845/2018.14-4.7>
- [21] Cacaïs, M.G., Sales, G.L. (2017). A collaborative system for corporate performance evaluation using gamification and the learning vectors model. In 2017 12th International Conference for Internet Technology and Secured Transactions (ICITST), Cambridge, UK, pp. 484-489. <https://doi.org/10.23919/ICITST.2017.8356455>
- [22] Ponis, S.T., Plakas, G., Agalinos, K., Aretoulaki, E., Gayialis, S.P., Andrianopoulos, A. (2020). Augmented reality and gamification to increase productivity and job satisfaction in the warehouse of the future. *Procedia Manufacturing*, 51: 1621-1628. <https://doi.org/10.1016/j.promfg.2020.10.226>
- [23] Hosseini, C., Humlung, O., Fagerstrøm, A., Haddara, M. (2022). An experimental study on the effects of gamification on task performance. *Procedia Computer Science*, 196: 999-1006. <https://doi.org/10.1016/j.procs.2021.12.102>
- [24] Najjar, M., Ghannouchi, S.A., Ghannouchi, S. (2021). GaBPM: An attempt for the enhancement of BP performance through gamification. *Procedia Computer Science*, 181: 835-842. <https://doi.org/10.1016/j.procs.2021.01.237>
- [25] Swacha, J. (2016). Gamification in enterprise information systems: what, why and how. In 2016 Federated Conference on Computer Science and Information Systems (FedCSIS), Gdansk, Poland, pp. 1229-1233. <https://doi.org/10.15439/2016F460>
- [26] Baxter, R.J., Holderness Jr, D.K., Wood, D.A. (2016). Applying basic gamification techniques to IT compliance training: Evidence from the lab and field. *Journal of Information Systems*, 30(3): 119-133. <https://doi.org/10.2308/isys-51341>
- [27] Alami, D., Dalpiaz, F. (2017). A gamified tutorial for learning about security requirements engineering. In 2017 IEEE 25th International Requirements Engineering Conference (RE), Lisbon, Portugal, pp. 418-423. <https://doi.org/10.1109/RE.2017.67>
- [28] DeCusatis, C., Gormanly, B., Alvarico, E., Dirahoui, O., McDonough, J., Sprague, B., Mah, B. (2022). A Cybersecurity Awareness Escape Room using Gamification Design Principles. In 2022 IEEE 12th Annual Computing and Communication Workshop and Conference (CCWC), Vegas, NV, USA, pp. 0765-0770. <https://doi.org/10.1109/CCWC54503.2022.9720748>
- [29] Broholm, R., Christensen, M., Sørensen, L.T. (2022). Exploring gamification elements to enhance user motivation in a cyber security learning platform through focus group interviews. In 2022 IEEE European Symposium on Security and Privacy Workshops (EuroS&PW), Genoa, Italy, pp. 470-476. <https://doi.org/10.1109/EuroSPW55150.2022.00056>
- [30] Ashley, T.D., Kwon, R., Gourisetti, S.N.G., Katsis, C., Bonebrake, C.A., Boyd, P.A. (2022). Gamification of cybersecurity for workforce development in critical infrastructure. *IEEE Access*, 10: 112487-112501. <https://doi.org/10.1109/ACCESS.2022.3216711>
- [31] Pratikto, D.A., Arifiansyah, F., Mulyanto, A. (2020). Interaction Design of Street Workout Application Using Gamification to Support Increased User Motivation to Workout. In 2020 7th International Conference on Advance Informatics: Concepts, Theory and Applications (ICAICTA), Tokoname, Japan, pp. 1-6. <https://doi.org/10.1109/ICAICTA49861.2020.9429034>
- [32] Setiawan, S.S., Suryadibrata, A. (2019). Fitrust: Promoting healthy lifestyle through gamified mobile health application. In 2019 5th International Conference on New Media Studies (CONMEDIA), Bali, Indonesia, pp. 26-30. <https://doi.org/10.1109/CONMEDIA46929.2019.8981840>
- [33] Straubinger, P., Fraser, G. (2022). Gamekins: gamifying software testing in jenkins. In Proceedings of the ACM/IEEE 44th International Conference on Software

- Engineering: Companion Proceedings, NY, USA, pp. 85-89. <https://doi.org/10.1145/3510454.3516862>
- [34] Sisomboon, W., Phakdee, N., Denwattana, N. (2019). Engaging and motivating developers by adopting scrum utilizing gamification. In 2019 4th International Conference on Information Technology (InCIT), Bangkok, Thailand, pp. 223-227. <https://doi.org/10.1109/INCIT.2019.8911976>
- [35] Marques, R., Costa, G., da Silva, M.M., Gonçalves, P. (2017). Gamifying software development scrum projects. In 2017 9th International Conference on Virtual Worlds and Games for Serious Applications (VS-Games), Athens, Greece, pp. 141-144. <https://doi.org/10.1109/VS-GAMES.2017.8056584>
- [36] Pedreira, O., García, F., Piattini, M., Cortiñas, A., Cerdeira-Pena, A. (2020). An architecture for software engineering gamification. *Tsinghua Science and Technology*, 25(6): 776-797. <https://doi.org/10.26599/TST.2020.9010004>
- [37] Cuevas-Martínez, J.C., Yuste-Delgado, A.J., Perez-Lorenzo, J.M., Triviño-Cabrera, A. (2019). Jump to the next level: A four-year gamification experiment in information technology engineering. *IEEE Access*, 7: 118125-118134. <https://doi.org/10.1109/ACCESS.2019.2932803>
- [38] Moldon, L., Strohmaier, M., Wachs, J. (2021). How gamification affects software developers: Cautionary evidence from a natural experiment on github. In 2021 IEEE/ACM 43rd International Conference on Software Engineering (ICSE), Madrid, ES, pp. 549-561. <https://doi.org/10.1109/ICSE43902.2021.00058>
- [39] Vertash, V., Aslam, H., Askarbekuly, N., Mazzara, M. (2021). Introducing Gamification Into Agile Processes Of A Game Development Company. In 2021 International Conference "Nonlinearity, Information and Robotics"(NIR), Innopolis, Russian Federation, pp. 1-6. <https://doi.org/10.1109/NIR52917.2021.9666143>
- [40] Remi-Omosowon, A., Cant, R., Langensiepen, C. (2016). Applying gamification principles to a container loading system in a warehouse environment. In 2016 UKSim-AMSS 18th International Conference on Computer Modelling and Simulation (UKSim), Cambridge, UK, pp. 79-84. <https://doi.org/10.1109/UKSim.2016.18>
- [41] Cunha Leite, R.M., Bastos Costa, D., Meijon Morêda Neto, H., Araújo Durão, F. (2016). Gamification technique for supporting transparency on construction sites: a case study. *Engineering, Construction and Architectural Management*, 23(6): 801-822. <https://doi.org/10.1108/ECAM-12-2015-0196>
- [42] Liu, M., Huang, Y., Zhang, D. (2018). Gamification's impact on manufacturing: Enhancing job motivation, satisfaction and operational performance with smartphone-based gamified job design. *Human Factors and Ergonomics in Manufacturing & Service Industries*, 28(1): 38-51. <https://doi.org/10.1002/hfm.20723>
- [43] Tsourma, M., Zikos, S., Albanis, G., Apostolakis, K.C., Lithoxidou, E.E., Drosou, A., Tzovaras, D. (2019). Gamification concepts for leveraging knowledge sharing in Industry 4.0. *International Journal of Serious Games*, 6(2): 75-87. <https://doi.org/10.17083/ijsg.v6i2.273>
- [44] Zhukova, O., Mandragelia, V., Alieksieienko, T., Semenenko, A., Skibina, E. (2023). Digital technologies for introducing gamification into the education system in the context of the development of industry 4.0. *Ingénierie des Systèmes d'Information*, 28(1): 141-147. <https://doi.org/10.18280/isi.280114>
- [45] Quiñones, D., Rojas, L. (2023). Understanding the customer experience in human-computer interaction: a systematic literature review. *PeerJ Computer Science*, 9: e1219. <https://doi.org/10.7717/peerj-cs.1219>
- [46] Eldor, L., Harpaz, I. (2016). A process model of employee engagement: The learning climate and its relationship with extra-role performance behaviors. *Journal of Organizational Behavior*, 37(2): 213-235. <https://doi.org/10.1002/job.2037>
- [47] Malinova, M., Gross, S., Mendling, J. (2022). A study into the contingencies of process improvement methods. *Information Systems*, 104: 101880. <https://doi.org/10.1016/j.is.2021.101880>
- [48] Pham, H., Brennan, L., Richardson, J. (2017). Review of behavioural theories in security compliance and research challenge. In *Informing Science and Information Technology Education Conference*, Ho Chi Minh City (Saigon), Vietnam, pp. 65-76. <https://doi.org/10.28945/3722>
- [49] Arena, M.J. (2004). Enhancing organizational awareness: An analysis of whole scale (TM) change. *Organization Development Journal*, 22(1): 9.

**Table A1.** Summary of examined studies

| Discipline                      | Research Tool             | Study | Research as Objective   | Main Findings   |
|---------------------------------|---------------------------|-------|---|---|
| Marketing & Customer Engagement | Survey                    | [9]   | Examine the impact of gamification on e-commerce websites and customer loyalty.   | - Gamification elements have a positive impact on attitude towards gamification and brand loyalty.  |
|                                 | Model                     | [10]  | Developed a word-of-mouth recommendation system that applied gamification techniques.   | - The developed system led to an increase in the average number of visits for both males and females by 100% and 116%, respectively.  |
|                                 | Interviews                | [11]  | Study the effect of applying gamification in retail marketing.  | - Gamification is mainly applied online and not physically (in-store).<br>- The main drivers of applying gamification are the achievement of KPI targets related to marketing, improve customer experience, and get customer recommendations.   |
|                                 | Survey                    | [12]  | Analyze how gamification affects brand engagement and awareness in online marketplaces. In addition, the impact of gamification features on the cognitive, social, emotional, affective, and behavioral dimensions. | - The study results highlighted that immersion features have an impact on the behavioral, cognitive, and social dimensions. Achievement features impact all dimensions (behavioral, cognitive, affective, emotional, and social). And lastly, social features can impact the social and cognitive dimensions. |
|                                 | Prototype                 | [13]  | Creating a game-like working environment.   | - The provided gamification features create competitive and fun environment.  |
| Human Resources                 | Model                     | [14]  | Job-matching model tools with the purpose of improving candidate learning and career paths.   | - Proposed recruitment model that combines recruitment and learning system that uses Gamification techniques.   |
|                                 | Model                     | [14]  | Job-matching model tools with the purpose of improving candidate learning and career paths.   | - Proposed recruitment model that combines recruitment and learning system that uses Gamification techniques.   |
|                                 | Case Study                | [15]  | Improve employee's well-being by building cloud-based gamified team-building application.   | - Most participants reported that they have experienced a change in the environment, with an easier and more relaxing atmosphere.   |
|                                 | Interviews<br>Focus Group | [16]  | Employee training to recommend courses and provide hints, badges, leaderboard.<br>Staffs are expected to deliver advanced IT solutions.   | - The outcome of the article is expected to introduce an attractive learning platform that can be accessed by all staffs.   |
|                                 | Prototype                 | [17]  | Developed a gamified Virtual Reality (VR) environment for employee training specific to the manufacturing industry with a learning pace that is suitable for the learner's background and dynamics.                 | - Provided a learning pace that is suitable for the learner's background and dynamics.  |
| Management                      | Case Study                | [19]  | Measure the effect of gamification in achieving social interaction and learning.  | - Results show that gamification can have an effect on fostering learning and social behavior.  |
|                                 | Case Study                | [20]  | Studied the impact of gamification on employee retention, motivation, and loyalty.  | - Applying gamification improves employee retention, motivation, and loyalty.   |
|                                 | Analysis of Case Studies  | [6]   | Study whether gamification improves performance for both employees and the organization.  | - A good gamification strategy and careful application design can drive business initiatives.   |
| Performance Management          | Questionnaire             | [21]  | Developed a system for performance evaluation and tasks monitoring.   | - The application had a positive impact in motivating employees and enhance collaboration between members.  |
|                                 | Survey                    | [22]  | Measure the acceptance of applying Augmented Reality (AR), gamification, or gamified.   | - The combination of gamification and AR is the most desired option.  |
|                                 | Case Study                | [23]  | Studied the impact of gamification on two user groups utilizing an application that they developed to promote healthy habits during Covid-19.   | - The test group outperformed the control group in terms of deliverables' quality.  |
|                                 | Model                     | [24]  | Outlined the lifecycle of the gamified business process management.   | - The suggested steps assist organization in applying gamification into their business processes.   |

| Discipline                                     | Research Tool            | Study | Research as Objective  | Main Findings  |
|--|--------------------------|-------|--|--|
| Awareness Campaigns<br>Cybersecurity Awareness | Analysis of Case Studies | [25]  | Studied how can gamification mechanics can be applied in Enterprise Information Systems (EIS).   | - Enterprise Information Systems are viable points of Gamification adoption.   |
|  | Case Study               | [26]  | The impact of gamification on Information Technology security.   | - Participants with less gaming experience enjoyed the gamified training more than those with gaming experience.   |
|  | Case Study               | [27]  | Propose a gamified platform for STS-ml language and security requirements training.  | - The gamified platform increased the number of participants in the training program.<br>- The platform received positive feedback on usability and engagement.  |
|  | Experiment               | [28]  | Improve user engagement and knowledge retention through training individuals on cybersecurity fundamentals such as cryptography and phishing scams.                    | - It received positive results after having it tested on 120 participants.<br>- The application's efficiency received high scores in the empowerment, avoidance, and accomplishment metrics.                               |
|  | Focus Group              | [29]  | Discovers some gaming elements that can improve user motivation in cybersecurity learning platforms.   | - The top picked elements by the groups were: customizable avatars, badges, and challenges are based on a storyline or a theme.  |
|  | Scenario Narratives      | [30]  | A gamified system that simulates realistic cyberattacks for cybersecurity training based on network security frameworks.   | - The players were provided with a variety of defensive strategies based on the National Institute of Standards and Technology (NIST) cybersecurity framework.   |
| Awareness Campaigns<br>Health Promotion        | Questionnaire            | [32]  | Developed a mobile application that encourages users to maintain a healthy lifestyle.  | - 74.59% of users felt immersed in the app and 81.43% reported that they will continue to use it in the future.  |
| Software Engineering                           | Case Study               | [31]  | With the help of gamification, the aim is to test the success of a mobile application where users are encouraged to exercise regularly and lead a healthier lifestyle. | - The application achieved a 93.3% completion rate with significant results.   |
|  | Prototype                | [35]  | A gamified JIRA add-on to help in increasing developers' motivation to adopt Scrum in software development.  | - A prototype was developed and it is being used to evaluate the real impact of gamification on scrum in a real-world organization.  |
|  | Case Study               | [33]  | To improve the software testing process through a tool that applies gamification.  | - The project came with significant results as the coverage increased by 7% and the number of tests increased by 20%.  |
|  | Case Study               | [34]  | To further engage and motivate software engineers, gamified Scrum approach was proposed.   | - Scrum helped increase the cooperation up to 35.5%.<br>- 30.4% of participants reported that it made the process more fun and engaging.   |
|  | Experimental Research    | [37]  | To maintain students' motivation in information technology engineering and improve the learning outcomes.  | - The student's assessment application was a success, most participants obtained good grades with high task completion rate.   |
|  | Case Study               | [36]  | To help in creating a gamified work environment through building a gamification engine.  | - Creating a gamified workplace by integrating custom-developed tools and off-the-shelf tools, while maintaining current tools.<br>- The rewards for actions in any tool accumulate in a centralized gamified environment. |
|  | Case Study               | [39]  | To apply gamification into the agile processes within a game development company.  | - The results showed that sprint velocity improved by an average of 50% after gamification adoption as well as employee productivity and loyalty.  |
|  | Case Study               | [33]  | To improve the software testing process.   | - After testing the tool on a software development company, the evaluation yielded in positive results, as project coverage increased by 7% and number of tests increased by 20%.  |
| Protection Environment                         | Case Study               | [41]  | To enhance transparency of production assignments.   | - Gamified Construction Project System helped in increasing the transparency in communicating weekly tasks assignment and policies.  |
|  | Case Study               | [42]  | A gamified job-design framework and the job characteristics model (JCM) application.   | - The application can have a notable impact on job motivation and satisfaction.  |
|  | Prototype                | [43]  | Encourage workers to participate in knowledge sharing activities in Industry 4.0 industrial environments.  | - This solution can help in solving common issues in the industry like insufficient worker training and inadequate experience.   |

**Table A2.** Summary of drivers to engage in gamification projects

| Driver  | Discipline                      | Study                   |
|---|---------------------------------|-------------------------|
| <b>1. Customer Experience</b>                       |                                 |                         |
| Improve brand loyalty                               | Marketing & Customer Engagement | [9]                     |
| Assist with product recommendations                 | Marketing & Customer Engagement | [10]                    |
| Enhance customer experience                         | Marketing & Customer Engagement | [11]                    |
| Boost customer engagement                           | Marketing & Customer Engagement | [12]                    |
| Create a competitive environment                    | Marketing & Customer Engagement | [13]                    |
| <b>2. Employee Engagement &amp; Development</b>     |                                 |                         |
| Encourage learning                                  | Human Resources                 | [14]                    |
|   | Human Resources                 | [16]                    |
|   | Human Resources                 | [18]                    |
|   | Cybersecurity Awareness         | [28]                    |
|   | Cybersecurity Awareness         | [29]                    |
|   | Cybersecurity Awareness         | [30]                    |
| Assist with team building                           | Performance management          | [21]                    |
| Boost employee engagement                           | Management                      | [19]                    |
|   | Management                      | [20]                    |
| Improve performance                                 | Management                      | [6]                     |
|   | Performance management          | [23]                    |
|   | Production environment          | [41]                    |
|   | Production environment          | [41]                    |
| Assist with performance evaluation                  | Performance management          | [21]                    |
| Increase productivity                               | Performance management          | [22]                    |
| Encourage knowledge sharing                         | Production environment          | [43]                    |
| Enhance retention                                   | Management                      | [20]                    |
| Improve job satisfaction                            | Performance management          | [22]                    |
|   | Production environment          | [41]                    |
| Improve employee loyalty                            | Management                      | [20]                    |
|   | Software engineering            | [39]                    |
| <b>3. Process &amp; Efficiency Improvement</b>      |                                 |                         |
| Enhance efficiency                                  | Human Resources                 | [17]                    |
|   | Software engineering            | [39]                    |
| Improve processes                                   | Performance management          | [24]                    |
|   | Performance management          | [25]                    |
|   | Software engineering            | [33]                    |
|   | Production environment          | [40]                    |
|   | Software engineering            | [36]                    |
| <b>4. Security &amp; Compliance</b>                 |                                 |                         |
| Assist with security requirements                   | Cybersecurity Awareness         | [27]                    |
| Raise security awareness                            | Cybersecurity Awareness         | [28]                    |
|   | Cybersecurity Awareness         | [29]                    |
|   | Cybersecurity Awareness         | [30]                    |
| <b>5. Organizational Awareness &amp; Motivation</b> |                                 |                         |
| Stimulate motivation                                | Cybersecurity Awareness         | [29]                    |
|   | Software engineering            | [35]                    |
|   | Software engineering            | [34]                    |
|   | Software engineering            | [37]                    |
|   | Software engineering            | [38]                    |
|   | Production environment          | [41]                    |
|   | Production environment          | [42]                    |
|   | Production environment          | [41]                    |
| Monitor tasks                                       | Performance management          | [21]                    |
| <b>6. Wellbeing</b>                                 |                                 |                         |
| Raise health awareness                              | Health promotion                | [32]                    |
|   | Health promotion                | [31]                    |
| <b>Summary Table</b>                                |                                 |                         |
| Element   | Associated Study                | Related Discipline      |
| Levels  | [27]                            | Cybersecurity Awareness |
|   | [15]                            | Human Resources         |
|   | [21]                            | Performance management  |
|   | [28]                            | Cybersecurity Awareness |
|   | [20]                            | Management              |
|   | [35]                            | Software engineering    |
|   | [37]                            | Software engineering    |
|   | [38]                            | Software engineering    |
|   | [14]                            | Human Resources         |

| <b>Element</b> | <b>Associated Study</b> | <b>Related Discipline</b>       |
|----------------|-------------------------|---------------------------------|
|                | [36]                    | Software engineering            |
|                | [31]                    | Health promotion                |
|                | [32]                    | Health promotion                |
|                | [34]                    | Software engineering            |
|                | [19]                    | Management                      |
|                | [33]                    | Software engineering            |
|                | [39]                    | Software engineering            |
|                | [27]                    | Cybersecurity Awareness         |
|                | [30]                    | Cybersecurity Awareness         |
|                | [29]                    | Cybersecurity Awareness         |
|                | [28]                    | Cybersecurity Awareness         |
|                | [20]                    | Management                      |
|                | [35]                    | Software engineering            |
|                | [38]                    | Software engineering            |
|                | [12]                    | Marketing & Customer Engagement |
|                | [22]                    | Performance management          |
|                | [31]                    | Health promotion                |
|                | [32]                    | Health promotion                |
|                | [34]                    | Software engineering            |
|                | [19]                    | Management                      |
|                | [15]                    | Human Resources                 |
|                | [21]                    | Performance management          |
|                | [16]                    |                                 |
|                | [23]                    | Performance management          |
|                | [42]                    |                                 |
|                | [35]                    | Software engineering            |
|                | [14]                    |                                 |
|                | [9]                     | Marketing & Customer Engagement |
|                | [40]                    |                                 |
|                | [32]                    | Health promotion                |
|                | [43]                    |                                 |
|                | [17]                    | Human Resources                 |
|                | [18]                    | Human Resources                 |
|                | [15]                    | Human Resources                 |
|                | [21]                    | Performance management          |
|                | [16]                    | Human Resources                 |
|                | [23]                    | Performance management          |
|                | [41]                    | Production environment          |
|                | [35]                    | Software engineering            |
|                | [14]                    | Human Resources                 |
|                | [9]                     | Marketing & Customer Engagement |
|                | [40]                    | Production environment          |
|                | [32]                    | Health promotion                |
|                | [43]                    | Production environment          |
|                | [17]                    | Human Resources                 |
|                | [41]                    | Production environment          |
|                | [35]                    | Software engineering            |
|                | [14]                    | Human Resources                 |
|                | [14]                    | Human Resources                 |
|                | [16]                    | Human Resources                 |
|                | [12]                    | Marketing & Customer Engagement |
|                | [9]                     | Marketing & Customer Engagement |
|                | [40]                    | Production environment          |
|                | [43]                    | Production environment          |
|                | [17]                    | Human Resources                 |
|                | [35]                    | Software engineering            |
|                | [34]                    | Software engineering            |
|                | [37]                    | Software engineering            |
|                | [38]                    | Software engineering            |
|                | [36]                    | Software engineering            |
|                | [31]                    | Health promotion                |
|                | [32]                    | Health promotion                |
|                | [33]                    | Software engineering            |
|                | [39]                    | Software engineering            |
|                | [41]                    | Production environment          |
|                | [42]                    | Production environment          |
|                | [35]                    | Software engineering            |

| <b>Element</b>                  | <b>Associated Study</b> | <b>Related Discipline</b>       |
|---------------------------------|-------------------------|---------------------------------|
|                                 | [9]                     | Marketing & Customer Engagement |
|                                 | [40]                    | Production environment          |
|                                 | [32]                    | Health promotion                |
|                                 | [19]                    | Management                      |
|                                 | [43]                    | Production environment          |
|                                 | [37]                    | Software engineering            |
|                                 | [38]                    | Software engineering            |
| Streaks                         | [36]                    | Software engineering            |
|                                 | [33]                    | Software engineering            |
|                                 | [39]                    | Software engineering            |
|                                 | [27]                    | Cybersecurity Awareness         |
|                                 | [30]                    | Cybersecurity Awareness         |
| Stories                         | [29]                    | Cybersecurity Awareness         |
|                                 | [28]                    | Cybersecurity Awareness         |
|                                 | [12]                    | Marketing & Customer Engagement |
|                                 | [23]                    | Performance management          |
|                                 | [11]                    | Marketing & Customer Engagement |
| Challenges                      | [35]                    | Software engineering            |
|                                 | [22]                    | Performance management          |
|                                 | [34]                    | Software engineering            |
|                                 | [15]                    | Human Resources                 |
|                                 | [21]                    | Performance management          |
| Rewards                         | [16]                    | Human Resources                 |
|                                 | [20]                    | Management                      |
|                                 |                         | Marketing & Customer Engagement |
|                                 | [16]                    | Human Resources                 |
|                                 | [11]                    | Marketing & Customer Engagement |
| Avatars                         | [9]                     | Marketing & Customer Engagement |
|                                 | [17]                    | Human Resources                 |
|                                 | [20]                    | Management                      |
| Personalization                 | [12]                    | Marketing & Customer Engagement |
|                                 | [32]                    | Health promotion                |
|                                 | [27]                    | Cybersecurity Awareness         |
| Puzzles                         | [28]                    | Cybersecurity Awareness         |
|                                 | [17]                    | Human Resources                 |
|                                 | [27]                    | Cybersecurity Awareness         |
| Easter Eggs                     | [28]                    | Cybersecurity Awareness         |
|                                 | [24]                    | Performance management          |
|                                 | [27]                    | Cybersecurity Awareness         |
| Countdowns                      | [28]                    | Cybersecurity Awareness         |
|                                 | [11]                    | Marketing & Customer Engagement |
| Quizzes                         | [19]                    | Management                      |
|                                 | [24]                    | Performance management          |
| Mentorship                      | [32]                    | Health promotion                |
|                                 | [27]                    | Cybersecurity Awareness         |
| Verbal / Visual / Sound Effects | [28]                    | Cybersecurity Awareness         |
| Video Games                     | [11]                    | Marketing & Customer Engagement |
| Competitions                    | [12]                    | Marketing & Customer Engagement |
| Social Interactions             | [15]                    | Human Resources                 |
| Experiential Activities         | [18]                    | Human Resources                 |
| Animation                       | [16]                    | Human Resources                 |
| Tokens of Appreciation          | [20]                    | Management                      |
| Penalties                       | [25]                    | Performance management          |
| Protection                      | [24]                    | Performance management          |
| Activity Feed:                  | [27]                    | Cybersecurity Awareness         |
| Game Master:                    | [27]                    | Cybersecurity Awareness         |
| Time Restriction:               | [27]                    | Cybersecurity Awareness         |
| Conformity Anchor:              | [27]                    | Cybersecurity Awareness         |
| Ratings                         | [34]                    | Software engineering            |
| Alerts                          | [34]                    | Software engineering            |
| Gems                            | [36]                    | Software engineering            |
| Voting                          | [39]                    | Software engineering            |
| Betting                         | [39]                    | Software engineering            |
| Rankings                        | [39]                    | Software engineering            |
| Social network                  | [39]                    | Software engineering            |
| Achievements                    | [42]                    | Production environment          |
| Dialogs                         | [36]                    | Software engineering            |



**Table A3.** Summary of gamification elements

| <b>Element</b> | <b>Associated Study</b> | <b>Related Discipline</b>       |
|----------------|-------------------------|---------------------------------|
| Levels         | [27]                    | Cybersecurity Awareness         |
|                | [15]                    | Human Resources                 |
|                | [21]                    | Performance management          |
|                | [28]                    | Cybersecurity Awareness         |
|                | [20]                    | Management                      |
|                | [35]                    | Software engineering            |
|                | [37]                    | Software engineering            |
|                | [38]                    | Software engineering            |
|                | [14]                    | Human Resources                 |
|                | [36]                    | Software engineering            |
|                | [31]                    | Health promotion                |
|                | [32]                    | Health promotion                |
|                | [34]                    | Software engineering            |
|                | [19]                    | Management                      |
|                | [33]                    | Software engineering            |
| [39]           | Software engineering    |                                 |
| Feedback       | [27]                    | Cybersecurity Awareness         |
|                | [30]                    | Cybersecurity Awareness         |
|                | [29]                    | Cybersecurity Awareness         |
|                | [28]                    | Cybersecurity Awareness         |
|                | [20]                    | Management                      |
|                | [35]                    | Software engineering            |
|                | [38]                    | Software engineering            |
|                | [12]                    | Marketing & Customer Engagement |
|                | [22]                    | Performance management          |
|                | [31]                    | Health promotion                |
|                | [32]                    | Health promotion                |
| [34]           | Software engineering    |                                 |
| [19]           | Management              |                                 |
| Points         | [15]                    | Human Resources                 |
|                | [21]                    | Performance management          |
|                | [16]                    |                                 |
|                | [23]                    | Performance management          |
|                | [42]                    |                                 |
|                | [35]                    | Software engineering            |
|                | [14]                    |                                 |
|                | [9]                     | Marketing & Customer Engagement |
|                | [40]                    |                                 |
|                | [32]                    | Health promotion                |
|                | [43]                    |                                 |
| [17]           | Human Resources         |                                 |
| [18]           | Human Resources         |                                 |
| Badges         | [15]                    | Human Resources                 |
|                | [21]                    | Performance management          |
|                | [16]                    | Human Resources                 |
|                | [23]                    | Performance management          |
|                | [41]                    | Production environment          |
|                | [35]                    | Software engineering            |
|                | [14]                    | Human Resources                 |
|                | [9]                     | Marketing & Customer Engagement |
|                | [40]                    | Production environment          |
|                | [32]                    | Health promotion                |
|                | [43]                    | Production environment          |
| [17]           | Human Resources         |                                 |
| Leaderboards   | [41]                    | Production environment          |
|                | [35]                    | Software engineering            |
|                | [14]                    | Human Resources                 |
|                | [14]                    | Human Resources                 |
|                | [16]                    | Human Resources                 |
|                | [12]                    | Marketing & Customer Engagement |
|                | [9]                     | Marketing & Customer Engagement |
|                | [40]                    | Production environment          |
|                | [43]                    | Production environment          |
| [17]           | Human Resources         |                                 |
| Progress bars  | [35]                    | Software engineering            |

| <b>Element</b>              | <b>Associated Study</b> | <b>Related Discipline</b>       |
|-----------------------------|-------------------------|---------------------------------|
|                             | [34]                    | Software engineering            |
|                             | [37]                    | Software engineering            |
|                             | [38]                    | Software engineering            |
|                             | [36]                    | Software engineering            |
|                             | [31]                    | Health promotion                |
|                             | [32]                    | Health promotion                |
|                             | [33]                    | Software engineering            |
|                             | [39]                    | Software engineering            |
| User interface              | [41]                    | Production environment          |
|                             | [42]                    | Production environment          |
|                             | [35]                    | Software engineering            |
|                             | [9]                     | Marketing & Customer Engagement |
|                             | [40]                    | Production environment          |
|                             | [32]                    | Health promotion                |
|                             | [19]                    | Management                      |
|                             | [43]                    | Production environment          |
| Streaks                     | [37]                    | Software engineering            |
|                             | [38]                    | Software engineering            |
|                             | [36]                    | Software engineering            |
|                             | [33]                    | Software engineering            |
|                             | [39]                    | Software engineering            |
| Stories                     | [27]                    | Cybersecurity Awareness         |
|                             | [30]                    | Cybersecurity Awareness         |
|                             | [29]                    | Cybersecurity Awareness         |
|                             | [28]                    | Cybersecurity Awareness         |
| Challenges                  | [12]                    | Marketing & Customer Engagement |
|                             | [23]                    | Performance management          |
|                             | [11]                    | Marketing & Customer Engagement |
|                             | [35]                    | Software engineering            |
|                             | [22]                    | Performance management          |
| Rewards                     | [34]                    | Software engineering            |
|                             | [15]                    | Human Resources                 |
|                             | [21]                    | Performance management          |
|                             | [16]                    | Human Resources                 |
| Avatars                     | [20]                    | Management                      |
|                             | [11]                    | Marketing & Customer Engagement |
|                             | [16]                    | Human Resources                 |
|                             | [11]                    | Marketing & Customer Engagement |
|                             | [9]                     | Marketing & Customer Engagement |
| Personalization             | [17]                    | Human Resources                 |
|                             | [20]                    | Management                      |
|                             | [12]                    | Marketing & Customer Engagement |
| Puzzles                     | [32]                    | Health promotion                |
|                             | [27]                    | Cybersecurity Awareness         |
|                             | [28]                    | Cybersecurity Awareness         |
| Easter Eggs                 | [17]                    | Human Resources                 |
|                             | [27]                    | Cybersecurity Awareness         |
|                             | [28]                    | Cybersecurity Awareness         |
| Countdowns                  | [24]                    | Performance management          |
|                             | [27]                    | Cybersecurity Awareness         |
| Quizzes                     | [28]                    | Cybersecurity Awareness         |
|                             | [11]                    | Marketing & Customer Engagement |
| Mentorship                  | [19]                    | Management                      |
|                             | [24]                    | Performance management          |
| Verbal/Visual/Sound Effects | [32]                    | Health promotion                |
|                             | [27]                    | Cybersecurity Awareness         |
| Video Games                 | [28]                    | Cybersecurity Awareness         |
| Competitions                | [11]                    | Marketing & Customer Engagement |
| Social Interactions         | [12]                    | Marketing & Customer Engagement |
| Experiential Activities     | [15]                    | Human Resources                 |
| Animation                   | [18]                    | Human Resources                 |
| Tokens of Appreciation      | [16]                    | Human Resources                 |
| Penalties                   | [20]                    | Management                      |
| Protection                  | [25]                    | Performance management          |
| Activity Feed:              | [24]                    | Performance management          |
| Game Master:                | [27]                    | Cybersecurity Awareness         |
|                             | [27]                    | Cybersecurity Awareness         |

| <b>Element</b>     | <b>Associated Study</b> | <b>Related Discipline</b> |
|--------------------|-------------------------|---------------------------|
| Time Restriction:  | [27]                    | Cybersecurity Awareness   |
| Conformity Anchor: | [27]                    | Cybersecurity Awareness   |
| Ratings            | [34]                    | Software engineering      |
| Alerts             | [34]                    | Software engineering      |
| Gems               | [36]                    | Software engineering      |
| Voting             | [39]                    | Software engineering      |
| Betting            | [39]                    | Software engineering      |
| Rankings           | [39]                    | Software engineering      |
| Social network     | [39]                    | Software engineering      |
| Achievements       | [42]                    | Production environment    |
| Dialogs            | [36]                    | Software engineering      |