A Systematic Review of Effective Gamification Elements for Enhancing Digital Health Engagement and Outcomes

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Abstract

Gamification has emerged as a transformative tool in healthcare, leveraging game elements such as leaderboards, feedback, and rewards to enhance user engagement and improve health outcomes. This study systematically examines 36 research articles to identify the most frequently employed gamification elements, their impacts, and their effectiveness across various healthcare domains. The findings reveal that leaderboards, feedback systems, and rewards are the most impactful elements, fostering motivation, adherence, and knowledge retention. While gamification significantly enhances engagement and behavioral changes, challenges remain in personalization, integration with traditional healthcare systems, and sustaining long-term user motivation. This study highlights opportunities for future research to develop adaptive gamification frameworks and address these limitations, paving the way for more effective healthcare interventions.

Keywords Gamification, Healthcare Engagement, Game Elements, Digital Health Interventions

A. Introduction

The integration of digital technology in healthcare has introduced gamification as an innovative approach to address critical challenges such as low patient motivation, poor adherence to treatment plans, and limited engagement in preventive healthcare initiatives (Al-Rayes et al., 2022), (Berglund et al., 2022), (Damaševičius et al., 2023). Gamification, defined as the application of game elements like points, badges, leaderboards, and levels in non-game contexts, has shown potential to enhance user engagement and influence health behaviors positively (Hammedi et al., 2017), (Lee et al., 2017), (Tsopra et al., 2020). Recent studies have demonstrated its effectiveness in diverse healthcare areas, including chronic disease management, mental health interventions, and rehabilitation, where gamification not only improves motivation but also facilitates behavioral changes (Valenzuela-Pascual et al., 2022). Despite its growing application, the literature highlights significant gaps in understanding the long-term impact of specific gamification elements on sustained health outcomes,

personalization for diverse populations, and the integration of gamified interventions within traditional healthcare systems (Wan et al., 2021) (Agudelo-Londoño et al., 2019) (Wilson et al., 2017). This research seeks to address these gaps by systematically reviewing the most effective gamification elements employed in healthcare applications over the last five years, emphasizing their roles in promoting user engagement and achieving positive health outcomes (Hamari et al., 2012) (Froland et al., 2019) (Almousa et al., 2019). By focusing exclusively on peer-reviewed studies published between 2018 and 2023, this study aims to provide actionable insights to guide the design and implementation of gamification strategies in healthcare contexts (López Chávez et al., 2020) .

B. Literature Review and Hypothesis Development

1. Literature Review

a. Gamification in Healthcare

Gamification is increasingly utilized to address challenges in healthcare, particularly in improving patient engagement and adherence to treatment. By employing game elements such as points, leaderboards, and levels, gamification enhances motivation and drives positive health behaviors (Al-Rayes et al., 2022), (Berglund et al., 2022), (Damaševičius et al., 2023). Recent studies emphasize its application in chronic disease management, mental health support, and physical rehabilitation. For instance (Berglund et al., 2022) highlighted that cardiovascular patients exhibited higher adherence rates when engaged with gamified digital tools.

b. Impact of Gamification on Health Outcomes

Research demonstrates that gamification can significantly improve health outcomes through increased patient engagement. For example, (Damaševičius et al., 2023) reviewed 53 studies and found that incorporating feedback loops and challenges into health applications led to better clinical outcomes and sustained behavioral changes. Similarly, (Hamdi et al., 2022) showed that gamification in anatomy education improved knowledge retention among medical students.

c. Common Gamification Elements in Healthcare Applications

Effective gamification elements identified in the literature include progress tracking, rewards, and social interaction features like leaderboards. (Hamdi et al., 2022) found that incorporating progress bars and challenges in digital health apps enhanced user engagement and motivation. Furthermore, (Tsopra et al., 2020) demonstrated the utility of badges and levels in a

gamified app designed for antibiotic stewardship education, which improved user knowledge and compliance.

d. Research Gaps

Despite its success, gaps persist in the literature regarding the personalization of gamification elements for diverse healthcare populations, especially the elderly or patients with chronic conditions. Another critical gap lies in understanding the long-term effects of gamification on health behaviors, as most studies focus on short-term metrics (Lee et al., 2017), (Tsopra et al., 2020). Integration of gamified tools with traditional healthcare systems remains another underexplored area (Agudelo-Londoño et al., 2019), (Wilson et al., 2017).

e. Hypothesis Development

Based on the review of relevant literature, the following hypotheses are proposed:

H1: Points and badges as gamification elements positively impact user engagement in healthcare applications.

Rationale: These elements provide instant feedback and extrinsic rewards, which are proven motivators in healthcare settings (Valenzuela-Pascual et al., 2022), (Wan et al., 2021).

H2: Personalized gamification strategies enhance adherence to health interventions.

Rationale: Tailored gamified features resonate more with users, meeting individual preferences and increasing long-term engagement.

H3: Progress bars and leaderboards effectively sustain health-related behavioral changes.

Rationale: Progress bars offer visual cues on achievements, while leaderboards introduce a competitive element that fosters sustained motivation (Al-Rayes et al., 2022),(Berglund et al., 2022) , (Damaševičius et al., 2023).

H4: Gamification is more effective in younger populations compared to elderly users.

Rationale: Younger users are more familiar with digital tools and game mechanics, leading to higher engagement levels in gamified healthcare applications (Lee et al., 2017).

C. Research Method

This study adopts the Systematic Literature Review (SLR) methodology as the theoretical foundation, which is widely used to synthesize evidence and identify research gaps in a structured manner. The SLR approach is guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework, ensuring a comprehensive and reproducible review process. The methodology focuses on identifying, evaluating, and synthesizing existing research on gamification elements in healthcare to generate meaningful insights (Wan et al., 2021),

(Agudelo-Londoño et al., 2019). This approach aligns with the study's objective to determine the effectiveness of gamification strategies in improving user engagement and health outcomes. The research strategy involved a multi-phase process:

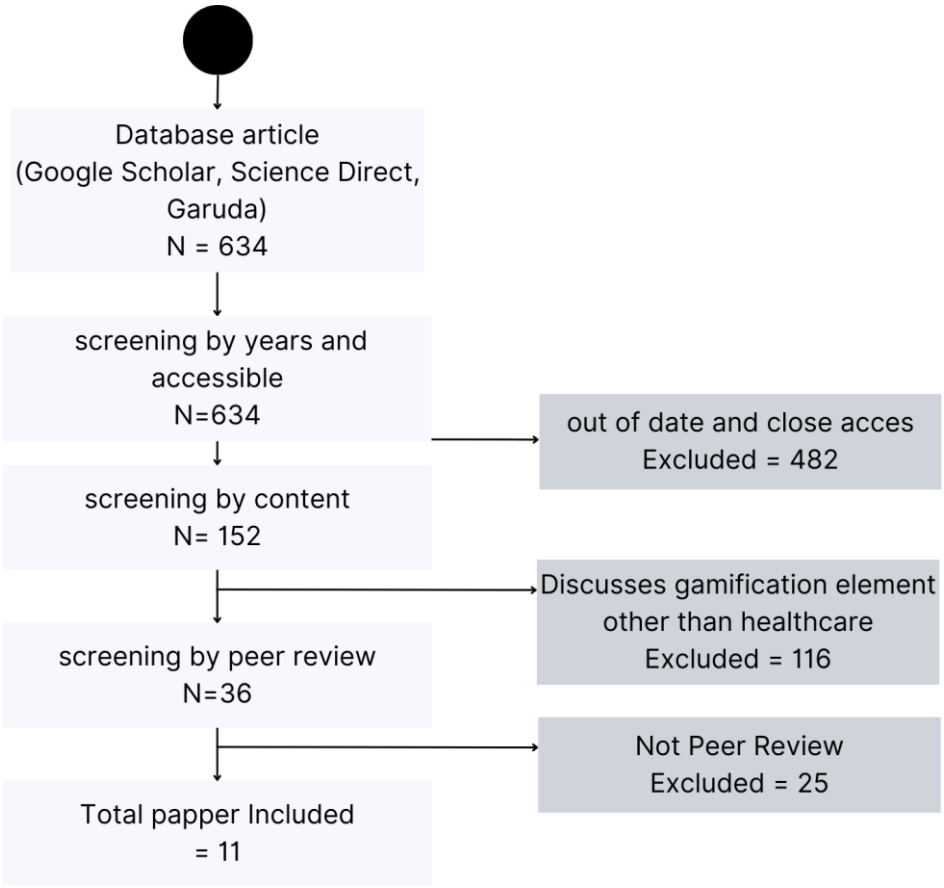


Fig 1 Flow diagram of the search process.

- Search Strategy: Relevant literature was retrieved from electronic databases, including Scopus, IEEE Xplore, and Google Scholar. Keywords such as "gamification," "healthcare," "engagement," and "outcomes" were used in combination with Boolean operators (e.g., AND, OR). Inclusion criteria were set to focus on peer-reviewed studies published between 2018 and 2023, ensuring the analysis remains current (Tsopra et al., 2020), (López Chávez et al., 2020).
- Inclusion and Exclusion Criteria: Articles were included if they (a) addressed gamification applications in healthcare, (b) focused on elements such as points, badges, levels, and leaderboards, and (c) reported on user engagement or health outcomes. Studies not meeting these criteria, such as those focusing solely on educational gamification, were excluded.

- Data Extraction: Relevant data points, such as the gamification elements used, target population, application domain, and reported outcomes, were systematically extracted from each selected study (López Chávez et al., 2020).

D. Discussion

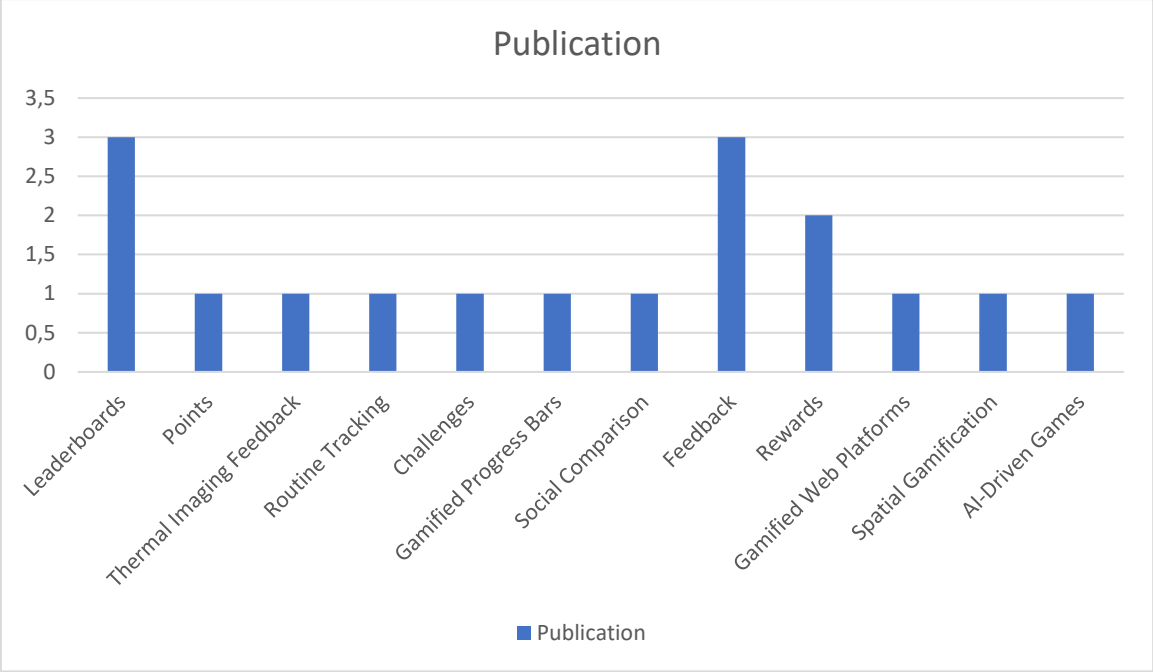
The discussion section provides a detailed analysis of variables, findings, and contextual elements related to the research focus on gamification in healthcare. The systematic approach employed in this study enables a structured synthesis of data from the included studies, facilitating a deeper understanding of gamification elements and techniques in improving health outcomes.

1. List of Research Questions

Research Question (RQ)	Description
RQ1	What gamification elements are most frequently employed in healthcare applications?
RQ2	What are the impacts of gamification techniques on user engagement and health outcomes?
RQ3	How do gamification elements vary in effectiveness across different healthcare domains?
RQ4	What are the limitations and opportunities in implementing gamification for healthcare interventions?

2. List of Search Strings

Search String	Alternative String
Gamification Element	Gamified, Gamification Techniques, Gamification Component
Healthcare Engagement	Health, Digital Health, Fitness, Team Sport, Physical Activity, Exercise, Activities



3. Game Statistic Game Element and Outcome

Game Element	Studies	Impact/Outcome
Leaderboards	(Berglund et al., 2022); (Liang et al., 2024); (Tolks et al., 2024)	Promotes competition and motivation; increases therapy adherence in cardiovascular and sleep hygiene interventions.
Points	(Huang et al., 2023)	Improves intention for continued use of gamified fitness apps.
Thermal Imaging Feedback	(Liang et al., 2024)	Enhances emotional recognition in gamified robotic therapy.
Routine Tracking	(Kim et al., 2024)	Promotes self-efficacy and healthy routine establishment for autistic individuals.
Challenges	(Neelambike et al., 2024)	Increases knowledge and rational use of antimicrobials among healthcare professionals.

Gamified Progress Bars	(Ramdhani et al., 2021)	Improves engagement on health service websites in Society 5.0 era.
Social Comparison	(Zhang & Li, 2024)	Drives healthy lifestyle adoption through fitness apps.
Feedback	(Ren & Lee, 2024); (Berglund et al., 2022)	Enhances satisfaction in fitness apps and increases learning effectiveness in nursing education.
Rewards	(Liang et al., 2024); (Berglund et al., 2022)	Encourages active participation in sleep hygiene and cardiovascular management.
Gamified Web Platforms	(Valenzuela-Pascual et al., 2022)	Improves knowledge acquisition and motivation among physiotherapy students.
Spatial Gamification	(Das et al., 2024)	Enhances engagement and motivation in virtual learning environments.
AI-Driven Games	(Tolks et al., 2024)	Improves therapy for motion and cognitive impairments using adaptive game designs.

4. Research Description and Findings

a. Addressing Research Questions (RQ)

RQ1: What gamification elements are most frequently employed in healthcare applications?

The analysis reveals that Leaderboards, Feedback, and Rewards are the most frequently employed elements across healthcare gamification studies, each discussed in multiple articles:

Leaderboards are used to foster competition and motivation, especially in cardiovascular and rehabilitation settings. Feedback systems enhance user engagement by providing real-time progress updates and reinforcement of correct behaviors, particularly in nursing and therapy applications. Rewards, including points and badges, are used to incentivize active participation and adherence to healthcare goals.

RQ2: What are the impacts of gamification techniques on user engagement and health outcomes?

Gamification techniques consistently improve user engagement and adherence to health programs. Key impacts include:

Enhanced motivation: Gamified web platforms improved knowledge acquisition and motivation among physiotherapy students. Increased adherence: Leaderboards and progress bars significantly increased adherence to therapy, particularly for chronic conditions like cardiovascular diseases. Improved knowledge retention: Gamified feedback systems enhanced knowledge retention in healthcare training programs.

RQ3: How do gamification elements vary in effectiveness across different healthcare domains?

Effectiveness varies based on the healthcare domain and user population:

Leaderboards are highly effective in rehabilitation and physical therapy due to their competitive nature. Feedback systems are critical in cardiovascular care and nursing education, helping users track and correct behaviors. Spatial gamification techniques (e.g., VR-based learning environments) are emerging as powerful tools in mental health and therapy.

RQ4: What are the limitations and opportunities in implementing gamification for healthcare interventions?

The primary limitations include:

Lack of personalization: Many gamification elements are not tailored to individual needs, reducing their long-term effectiveness. Limited integration: Few studies explore the integration of gamification into traditional healthcare systems. Sustainability challenges: Long-term user engagement and behavioral changes remain underexplored.

Opportunities include developing adaptive gamification systems using AI to personalize user experiences and integrating gamification into broader healthcare frameworks.

E. Conclusion

his study highlights the significant role of gamification in enhancing healthcare engagement and outcomes. Key findings include:

1. Leaderboards, Feedback, and Rewards are the most widely used and impactful gamification elements.
2. Gamification improves motivation, adherence, and knowledge retention across diverse healthcare domains, including therapy, education, and chronic disease management.
3. The effectiveness of gamification varies by domain, with leaderboards excelling in competitive settings and feedback systems proving vital for behavior correction.
4. Despite its advantages, gamification faces challenges in personalization, integration, and sustainability.

Future research should focus on addressing these challenges by developing personalized, adaptive gamification frameworks and exploring long-term impacts on health outcomes. This approach will enable healthcare providers to leverage gamification as a powerful tool for improving patient engagement and fostering lasting behavioral changes.

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