Digital Serious Games in Healthcare Management: Comparative Analysis and Design Recommendations

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Abstract: Introduction Digital serious games (DSGs) enable healthcare management students to safely navigate the systemic complexities of the sector. However, domain-specific comparative frameworks remain scarce. Objectives: This study addresses three research questions (RQs): (RQ1) What comparative characteristics can be identified for the analysis of serious games in healthcare management? (RQ2) What similarities and differences emerge between the serious games based on these characteristics? and (RQ3) Which recommendations can be derived for the design of DSGs for teaching? Methods: To address RQ1, a literature review across four databases identified five sources describing game characteristics, design principles, and pedagogical principles. Following a relevance assessment by five researchers, the identified characteristics were synthesized into a comparison matrix comprising five clusters: formal game structure and interaction; learning objectives (LOs) and measurability of results; game rules, game dynamics, and decision-making structures; resources and game environments; and aesthetic aspects and didactics. To address RQ2, the matrix was applied to five healthcare management DSGs. The analysis drew on publicly available materials, demo versions, structured interviews with providers or experts, and supplementary provider materials. Based on the comparative findings, competency-oriented design recommendations (DRs) were derived to address RQ3. Results: The comparison revealed several recurring characteristics across the analyzed DSGs. Considerable variation was identified in player interaction, game duration, strategic flexibility, feedback mechanisms, and the representation of healthcare-specific complexity. Based on these findings, ten DRs were developed, emphasizing multi-role structures, LO-aligned game mechanics and feedback, flexible strategic decision-making, multidimensional performance indicators, explicit resource constraints, increasing complexity, and risk-free experimentation. Discussion: The findings indicate that competency-oriented DSG design requires alignment between LOs, game mechanics, decision structures, and feedback mechanisms. However, the study was limited to five specialized DSGs and examined design characteristics rather than learner experiences or effectiveness. Future studies should assess the effects of the proposed DRs on learning outcomes, competency development, strategic decision-making, and learner engagement. Conclusion: The study provides an initial, literature-informed comparison matrix and ten provisional DRs for competency-oriented DSGs in healthcare management. The DRs offer a basis for developing future learning environments that reflect the specific complexity of healthcare management.

Keywords: Simulation Games, Serious Games, Healthcare Management, E-Learning, Design

1. Introduction

Digital serious games (DSGs) are increasingly recognized as a crucial e-learning approach, enabling students to interact with complex, practice-oriented scenarios in a risk-free, interactive environment. DSGs can be viewed as innovative educational tools that provide students with interactive, motivating, and engaging learning experiences, thereby fostering cognitive and social skills (Anastasiadis *et al.*, 2018). Using a game-based approach in teaching incorporates playful elements in a friendly competitive environment to boost learners' motivation and interest, support them in achieving learning objectives (LOs), and improve skills (Cavus *et al.*, 2023). This prepares learners for professional practice by developing the competencies they will need in their future roles. The potential applications of serious games are diverse, ranging from educational games for children to simulation environments for industry or for use in education to raise awareness about managing illness (Dörner *et al.*, 2016).

This approach is particularly relevant for healthcare management students, given that organizations in this sector have highly complex systems involving diverse stakeholder groups and competing objectives. Today, healthcare managers must navigate complex, multidimensional systems, coordinate numerous stakeholders, implement new technologies and regulations, stay within budgetary constraints, and simultaneously ensure the highest levels of patient safety and quality of care (Spanos *et al.*, 2024). The complexity of the system is also evident in

the changing demands placed on healthcare leaders. Accordingly, leadership in this system requires not only an understanding of roles and competencies, but also a focus on goals, the promotion of a corporate culture, and the targeted promotion of innovation (Spanos *et al.*, 2024).

Various generic frameworks exist for the comprehensive analysis of serious games. However, generic models for analyzing serious games, such as the Learning Mechanics – Gaming Mechanics Model (LM-GM) model (Arnab *et al.*, 2015) and the Serious Game Design Assessment Framework (SGDAF) (Mitgutsch and Alvarado, 2012), are insufficient for this purpose, as they fail to consider the distinctive features of the healthcare sector and the contemporary understanding of the role of healthcare managers.

To address this critical gap, this study aims to conduct a sector-specific analysis of existing DSGs, evaluate these DSGs, and develop design recommendations (DRs) for future development. This is essential to ensure that future healthcare managers are equipped with evidence-based, competency-oriented digital learning tools that reflect real-world institutional complexities. Based on these topics, the following research questions (RQs) have arisen:

RQ1: What comparative characteristics can be identified for the analysis of serious games in healthcare management?

RQ2: What similarities and differences emerge between serious games based on these characteristics?

RQ3: Which recommendations can be derived for the design of DSGs for teaching?

2. Theoretical Background

2.1 Digital Serious Games in E-Learning

Dörner et al. (2016) define a serious game as “a digital game created with the intention to entertain and to achieve at least one additional goal (e.g., learning or health).” In the context of serious games in healthcare management, this additional goal is learning. Consequently, the game development team needs subject matter experts to create serious games. Developing serious games remains a challenge, even though their benefits have long been recognized (Dörner *et al.*, 2016).

2.2 Healthcare Management as Learning Context

This raises the question of how the learning context of healthcare management can be situated in this context. Healthcare management is essentially a distinct branch of training within healthcare professions. It focuses on developing competencies at systemic level, such as quality management, policy, and crisis communication. The field of healthcare management differs fundamentally from general medical training, which primarily focuses on clinical competencies. The study of hospital management examines organizational performance and how decisions influence systems and organizations (Zhang *et al.*, 2026).

2.3 Existing Frameworks for Serious Games Analysis

In the field of serious games analysis, there are frameworks that address this topic more broadly. In this context, Mitgutsch & Alvarado (2012) developed a framework that analyzes serious games based not on their entertainment value or content, but rather on the formal connection between the game’s elements and the LOs. This framework is named “SGDA-Framework”, and it defines six dimensions that must be integrated into a serious game: Purpose; Content and Information; Game Mechanics; Fiction and Narrative; Aesthetics and Graphics; Framing; Coherence and cohesiveness of the game (Mitgutsch and Alvarado, 2012). Another framework for the analysis of serious games is the “Learning Mechanics-Game Mechanics Framework” by Arnab *et al.* (2015). It is designed to support the analysis and design of serious games by mapping the relationship between pedagogical elements and game mechanics. The model consists of two main systems: Learning Mechanics (LMs) and Game Mechanics (GMs). These are connected through a descriptive framework that enables users to generate maps and tables illustrating static and dynamic relationships between educational and gaming elements (Arnab *et al.*, 2015).

Although these frameworks are a theoretical basis for analyzing serious games, there is a lack of a systematic and comparative analytical tool in the field of serious games in healthcare management. Furthermore, it remains unclear how existing serious games represent specific systemic complexity of the healthcare system. This study addresses this gap by developing a literature-based comparison matrix that was directly applied to five

established DSGs in healthcare management (Elwacon Business Partner, 2026; HFX Training, 2026; MEGA Learning, 2026; SimInstitute, 2026; TopSim, 2026).

3. Methods

3.1 Framework Development

Regarding the first research question (RQ1), a generic literature review was conducted across four databases to identify relevant dimensions for serious games in healthcare management. The databases used for this purpose were SpringerLink, the internal database of Osnabrück University of Applied Sciences ("scinos"), PubMed and Google Scholar. Search strings were developed using Boolean operators (AND, OR). The database search was performed combining keywords such as "game", "game design", "serious games", "digital serious games", and "learning by design".

Five sources were found that define and describe the dimensions of a game (Fullerton, 2024; Gee, 2004; Hunicke *et al.*, 2004; Schell, 2008; Zagal and Bruckman, 2009). In the next step, frameworks were extracted from the literature. Overall, categories were established that encompass the general framework of a game, the design principles, and the pedagogical principles. These initial frameworks were discussed with five researchers to ensure validity and applicability to DSGs in healthcare management.

To cluster the frameworks and dimensions in the next step, we looked for commonalities in their content so that groups with similar thematic focuses could be formed. Categories with identical content were merged. Additionally, the frameworks were evaluated based on expert consensus. The research team evaluated all categories using a 3-point rating scale (1 = lowest relevance, 3 = highest relevance) to ensure a clear distinction between low, moderate, and high relevance without forced granular nuances. Frameworks and dimensions were assigned a score of 1 if not relevant to the development of management competencies, or if, although they were relevant, they appeared to be better understood when considered alongside other categories in a different context. A rating of 3 indicated a high level of relevance for teaching management competencies or the fundamental elements of a DSG. All categories were evaluated using this scale. Categories with a rating of 1 were then excluded. This led to the exclusion of the following categories: roles of players (Fullerton, 2024); agent goals (Zagal and Bruckman, 2009); object attributes (Schell, 2008); entity manipulation (Hunicke *et al.*, 2004; Zagal and Bruckman, 2009); checkpoint, cropping, expiration, Pseudo-physical Rules, save point, spawn point (Zagal and Bruckman, 2009); operational rules, foundational rules, behavioural rules, written rules, laws, official rules, advisory rules, house rules (Schell, 2008); information on demand or just in time (Gee, 2004); meaning as action image (Gee, 2004); Sensation, fantasy, narrative, Challenge, fellowship, discovery, expression, submission (Hunicke *et al.*, 2004); Cycles of expertise challenge (Gee, 2004) and Pleasantly frustrating (Gee, 2004).

3.2 Comparative Analysis

To answer the second research question (RQ2), 18 DSGs in the field of healthcare management were identified through an open-ended search on the "Google" search engine in February 2026. Search terms such as "healthcare management game", "serious games", "simulation games", "hospital business games" or "hospital management game" were used. The identified DSGs were then subsequently categorized according to teaching applications, competency-oriented designs, and exclusive use within the healthcare sector. The DSGs were ultimately analyzed based on the clusters and categories identified in the systematic analysis.

Data on the DSGs was gathered from four sources:

1. Information sourced from open-access web resources and collateral public materials;
2. demo version of the DSG;
3. interview with the provider or expert of the serious game and
4. exclusive materials from the providers.

Initially, a comprehensive review of publicly accessible informa

tion was conducted, which included open-access web resources and marketing or educational materials (1). To gain a deeper understanding of the DSGs, the providers were asked to provide access to a demo version and to participate in an interview. Not all DSGs were able to provide a demo version. Where possible, the demo versions were used to analyze design elements and content of a DSG (2). The interviews with the providers were

conducted using a structured interview guide (Helfferich, 2009) (3). In addition, the providers provided access to exclusive supplementary materials that were not freely available (4).

To ensure complete traceability and transparency throughout the analysis, a documentation system was established. Each piece of information collected was systematically assigned a reference number from (1) to (4) that corresponded directly to the specific data source from which it originated. This allowed for a clear and comprehensive mapping of information.

4. Results and Analysis

4.1 The Five Analysis Clusters

The dimensions of a game were identified based on various sources, resulting in five distinct clusters.

Cluster (a) “Formal Game Structure and Interaction” describes the general framework and control mechanisms of a game. The thematic focus of this cluster is on the number of players, how players or teams interact with or against each other, and how players’ actions are reflected in the game.

Cluster (b) “Learning Objectives and Measurability of Results” focuses on classification and types of goals as well as measurability and difficulty. To improve comparability, all LOs of the DSGs were first compiled, and then subcategories were formed based on content overlaps. These subcategories were then described using a keyword. This resulted in a total of eight general LOs. Furthermore, ways to win the game, and how to measure success in the game were analyzed.

Cluster (c) “Game Rules, Game Dynamics and Decision-Making-Structure” describes the defined set of rules, game structural flow, and decision-making logic within the game. The core dimensions of this cluster include the game world and specific aspects of gameplay, such as player briefings, the number of decision rounds, and the development of game strategy.

Cluster (d) “Resources and Game Environments” deals with spatial representation of the game, object structure, definition and significance of resources. Within these categories, the resource, their availability, and the space of the game were analyzed. The fifth Cluster (e) “Aesthetic Aspects and Didactics” places a central emphasis on game design and its educational applications. In particular, the analysis focuses on basic principles of game-based learning and the presentation of the game.

4.2 Comparative Analysis of Serious Games

The five clusters enabled a systematic analysis of the DSGs across several dimensions. To illustrate basic elements of a DSG, elements that are common to all DSGs were highlighted. This helped to illustrate the basic elements of a DSG in healthcare management.

4.2.1 Cluster (a): “Formal Game Structure and Interaction”

As Table 1 shows, an analysis of formal game structure and interaction in the simulation revealed that all DSGs were digital applications that employed an indirect manipulation method within the game. The differences lie primarily in number of players and in player interaction patterns. All forms of player interaction patterns were present here. The DSG analysis allowed for both single player and team to play against a computer, as well as team play against other teams. The DSG “Healthcare Hero” could even be configured to accommodate all player interaction patterns. In terms of the number of players, team games tended to involve groups of up to five people, divided into three to five teams.

Table 1: Formal Game Structure and Interaction - Matrix (Cluster a); abridged version

Design Elements	Comparison Dimensions	Comparative Features	Healthcare Hero (HFX Training)	Healthcare Strategy Challenge (MEGA Learning)	Hospital Business Management (Elwacon)	Hospital Operations (Sim-Institute)	Hospital Management (TopSim)
Players	Number of Players (Single- vs. Multiplayer)	Single-player, multiplayer, or teams?	Standard team size between 3-5, Cohort size unlimited but	Groups of 4–5, 3–5 teams	25 players max., at least 9 players, at	Single- and multiplayer	Multiplayer

Design Elements	Comparison Dimensions	Comparative Features	Healthcare Hero (HFX Training)	Healthcare Strategy Challenge (MEGA Learning)	Hospital Business Management (Elwacon)	Hospital Operations (Sim-Institute)	Hospital Management (TopSim)
			usually between 5-10 teams		least 3 groups		
Players	Player Interaction Patterns	Single player vs. Game, Multiple individual players vs. Game, Player vs. Player, Unilateral competition, multilateral competition, Cooperative play, Team competition	Single player vs. Game, Multiple individual players vs. Game, Player vs. Player, Unilateral competition, multilateral competition, Cooperative play, Team competition	Cooperative Play	Multilateral team competition	Single player vs. game; Cooperative Play	Multilateral team competition
Input Method	Locus of Manipulation	Direct and indirect manipulation	Indirect manipulation	Indirect manipulation	Indirect manipulation	Indirect manipulation	Indirect manipulation
	Manipulation Method	Analog vs. digital, gestic, buttons	Digital	Digital	Digital	Digital	Digital

4.2.2 Cluster (b): "Learning Objectives and Measurability of Results"

Analyzing LOs and the measurability of results provided a fundamental evaluation of instructional goals and an understanding of success within the games. Fullerton (2024) identified ten different game objectives in principle. The general objective of all DSGs in healthcare management was "construction" (Fullerton, 2024), meaning that the goal was to manage objects. The analysis of the LOs began by compiling all stated LOs gathered from various sources. All LOs identified through the research were grouped based on commonalities, resulting in eight LOs. However, when interpreting Table 2, it must be critically noted that the evidence for the respective LOs predominantly based of public materials (P) and the self-reported statements of providers during interviews (I). An objective verification of actual game mechanics using demo versions (D) was only possible in exceptional cases, such as partially for "Hospital Operations".

Table 2: Learning Objectives (LOs) and Measurability of Results - Matrix (Cluster b); abridged version

Learning Objective (LO)	LO Description	Healthcare Hero (HFX Training)	Healthcare Strategy Challenge (MEGA Learning)	Hospital Business Management (Elwacon)	Hospital Operations (Sim-Institute)	Hospital Management (TopSim)
LO1: Strategy Development	Strategic management in the context of strategy development and goal setting	I	P	P	P	I
LO 2: System Thinking	Comprehensive understanding of hospital operations and system thinking	I	P	P	P	I
LO 3: Data-driven Decision Making	Analysis of management-relevant data and data-driven decision-making	I	P	P	D	I
LO 4: Teamwork	Teamwork and interdisciplinary collaboration	I	P	P	D	I

Learning Objective (LO)	LO Description	Healthcare Hero (HFX Training)	Healthcare Strategy Challenge (MEGA Learning)	Hospital Business Management (Elwacon)	Hospital Operations (Sim-Institute)	Hospital Management (TopSim)
LO 5: Working efficiently	Optimizing Resource Management and Cost-Effectiveness	I	P	P	D	I
LO 6: Leadership skills	Gain an understanding of your own leadership role and the company's overall leadership role	I	P	P	P	I
LO 7: Multidimensional Impact Analysis	Understanding the impact of management decisions on patient outcomes, staff, and financial results	I	I	I	P	I
LO 8: Transfer effectiveness	Understanding of the effective use of simulation exercises to teach LOs in the strategic management of hospitals	I	I	I	P	I

Note: Letters in the table indicate the data source used to verify each LO; P – Information sourced from open-access web resources and collateral public materials, D – Demo version of the SG, I – Interview with the provider or expert of a SG.

Across available sources, evidence corresponding to each of the eight synthesized LO categories was identified for all five DSGs. To understand how these LOs were practically facilitated, the structural design of conflict was analyzed, specifically focusing on opponent structure. Here, differences became apparent. In DSGs, which were multilateral team competitions, the opponent in the game was another team. In a game with the player interaction pattern of a cooperative game, the opponent was a non-player opponent. One DSG even allowed for both opponent structures. In contrast, all DSGs were win/lose-games, meaning that at the end of the game, a winner was determined based on specific criteria. These criteria also varied widely and represented another key aspect of a DSG in healthcare management. There were three ways to win a DSG: the players with the highest overall score, winning criteria that compared each team against another, and selection criteria supplemented by an assessment of soft skills. Another factor that had to be considered when evaluating the winning criteria was the number of key performance indicators (KPIs) analyzed. It appears that between six and 20 KPIs were analyzed as part of the DSGs winning criteria. Performance was evaluated across all games based on financial criteria and stakeholder criteria, such as patient satisfaction. Results were presented via dashboards or tables. One simulation relied on a KPI matrix, while another used an AI-powered feedback system in a chat format.

4.2.3 Cluster (c) "Game Rules, Game Dynamics and Decision-Making Structure"

Next, the defined set of rules, the games structural flow, and decision-making logic within the games were analyzed. The borders of the simulation environment were the same for all DSGs and were limited to the analysis of a hospital at organizational level. Differences were evident in the size of the game world. The number of beds ranged from 207 to 300, and there were typically three departments within the game world. Special attention was paid to DSG structures. The overall playtime of the game showed that, despite many similarities, we are talking about fundamentally different game models. This was evident because typical duration ranged from 75 minutes to several days, though it is generally flexible. The briefing and debriefing structure illustrated how players were prepared for the game and guided through it as it progressed. Typically, players were introduced to the game using materials such as handouts, videos, or manuals; this was followed by a debriefing and discussion of how the game went. In addition, practice rounds could be played before the game began, to give players a feel for the game mechanics. For all DSGs, decisions were made at the end of a period, which typically spanned one year. Some decisions were made independently, while others had to be made within the framework of policies. The focus was on investments, salaries, and performance and capacity planning. Differences also emerged in the development of the game strategy. Games might dictate a strategy or allow players to develop their own strategy, which was then adapted as the game progressed. The tension usually stems from time pressure or pressure from opponents. The analysis also highlighted the importance of a systems-thinking approach in game design.

4.2.4 Cluster (d) "Resources and Game Environments"

The analysis of resources and game environments focused on the spatial representation of the game, the object structure, definition and significance of resources. DSGs in healthcare management were the same in their two-dimensional representation, their discrete spatial representation, and the availability of limited resources. The resources available to players in this context were similar and included, for example, financial budgets, staffing capacity, stakeholders or salary caps. In addition, the deployment method used in newer games is web-based, although one game still ran on a desktop. When examining the game objects within the context of resources and the game environment, it became clear that the games primarily relied on decision pages, dashboards, and reports. Other features here included news, reports and a glossary.

4.2.5 Cluster (e) "Aesthetic Aspects and Didactics"

An analysis of the game design revealed that none of the DSGs use audio content. The Learning by Design approaches are implemented in various ways. To begin with, players took an active role within learner agency. Roles that players could assume within the DSGs included strategic management HR, controlling and project management. Another principle of Learning by Design concerns the adaptability of difficulty levels. Some DSGs offered this, some did not. This was also the case with "well- ordered problems", namely whether players had to solve easier problems first and then move on to harder ones. The sandbox principle was also analyzed. This principle determines whether players can gain experience in a risk-free environment. The experiences players can gain through the DSGs include, for example, capacity planning, financial management, human resources, and marketing. According to some sources, the fishtank-principle, which was the simplified representation of a complex system, was applied here across all possible areas of a hospital.

4.3 Design Recommendations

The comparison matrix enabled a comparative analysis of five DSGs in healthcare management, revealing not only similarities and differences but also the fundamental principles of game design in this specific field. Based on these findings, in the next step DRs were developed to guide the future development of DSGs (RQ3).

4.3.1 Cluster (a): "Formal Game Structure and Interaction"

DR1: Use a multiplayer and multi-role structure.

Almost all games feature a multiplayer mode. However, complex stakeholder relationships can be presented not only by a team but also by different roles. The inclusion of different role perspectives should be considered to illustrate the dynamics within the healthcare system. Furthermore, DSGs could assign different roles within teams, which would be presented to players through different interfaces. For example, HR, financial control, and strategic management are distributed among the team members.

DR2: Use a digital platform and incorporate various supplementary materials.

A digital platform should allow players to access the game regardless of the device they use. Depending on the learning context, both digital and analog supplementary materials can be incorporated. When it comes to using digital tools, there are many possibilities. In addition to AI feedback tools, virtual reality content, for example, could also contribute to learning success. Given the limitless design possibilities, it is highly recommended to strategically select and integrate the specific supplementary materials that best align with the target LOs.

4.3.2 Cluster (b): "Learning Objectives and Measurability of Results"

DR3: Teach the competencies that hospital managers need in their daily work.

Teaching management competencies is the primary goal of DSGs in the healthcare sector. LOs should be oriented toward these competencies. The question of which competencies are essential for hospital managers remains contested. A systematic development of LOs from these competencies informed by literature and practical expertise is needed to align them with the DSG design and ensure their ongoing relevance in a rapidly changing healthcare environment.

DR4: Establish multidimensional performance metrics with LO-aligned feedback mechanisms

Evaluate success by deploying a balanced, multidimensional KPI matrix that integrates financial metrics, patient and staff needs, and quantified soft skills. It is crucial that the chosen feedback method be tailored to the specific

characteristics of each LO. Complex leadership skills cannot be taught only using quantitative, static data. Instead, they require conversational, analytical feedback.

4.3.3 Cluster (c) "Game Rules, Game Dynamics and Decision-Making Structure"

DR5: Implement a game flow that supports the achievement of LOs.

The flow of the game should be structured around the LOs, both in terms of time and subject matter. It may be useful to follow fiscal years or quarters but depending on context the game can also progress through project phases. Briefing and debriefing phases should be incorporated to evaluate progress and introduce new content. The ability to adjust the game's length allows for better alignment with individual LOs.

DR6: Provide flexible strategic decision-making.

Decision-making is one of the game's central challenges. There are various ways to structure this, and the right approach depends on the game's objective. Decision options can be either predetermined or freely chosen. Having a variety of decision options allows for greater flexibility.

4.3.4 Cluster (d) "Resources and Game Environments"

DR7: Represent resource constraints explicitly and adherence to actual hospital capacity metrics.

The hospital structure in the game should be based on real-world hospital metrics. Factors such as the number of beds and specialized departments provide a realistic framework for hospital planning. While budgets, staffing, and bed capacities act as strict operational limits during gameplay, they must function as dynamic, adjustable management levers that players can strategically expand and optimize over time.

DR8: The design must focus on illustrating the impact of decisions.

DSGs use dashboards or tables to visualize game results. The guiding principle here should be that DSGs are designed in such a way that players gain an understanding of the impact of their decisions. While dashboards and tables can certainly be used to illustrate these impacts, for example special reports, newspaper articles, or employee surveys can also serve this purpose.

4.3.5 Cluster (e) "Aesthetic Aspects and Didactics"

DR9*:* The complex dynamics of the healthcare system should be reflected in the design.

These complex dynamics pose a major challenge for healthcare managers. The representation of these complex dynamics should always be simulated in the game. Complexity can be illustrated, for example, by different stakeholder perspectives, roles with varying interests, or unforeseeable events.

DR10: Build in increasing complexity and enable risk-free experimentation.

Incorporating an increasing level of complexity helps keep players engaged (Gee, 2004). This can be achieved by starting with simple information or by limiting the game world at start. Test runs help players understand the game's dynamics and the consequences of their decisions.

5. Discussion

This study aimed to identify relevant characteristics for analyzing DSGs in healthcare management, to compare DSGs based on these characteristics, and to derive initial DRs for educational game development. The findings show that DSGs in healthcare management can be systematically compared using a literature-informed analytical structure. This matrix should be understood as an initial analytical heuristic that brings together relevant dimensions from existing serious game literature and applies them to a specific educational field. In doing so, the study provides a structured basis for making similarities and differences between existing DSGs visible.

The literature-based individual characteristics are generally known for describing the features of a DSG. The comparative analysis and adaptation, presented in form of a matrix, provided deep insight into sector-specific characteristics that consider the unique features of healthcare management. The final DRs represent a concrete outcome that goes beyond the generic principles of established frameworks. Across the five analyzed DSGs, recurring features were identified, including digital implementation, decision-based gameplay, limited resources, performance-oriented feedback, and competency-oriented LOs. At the same time, the comparison revealed considerable variation in interaction patterns, game duration, decision-making flexibility, feedback mechanisms,

and the extent to which healthcare-specific complexity is represented. The analysis suggests that existing DSGs in healthcare management share a common pedagogical core. All games address the same LOs and include elements related to teamwork, leadership, and resource optimization. From an LM-GM perspective, the mere presence of LOs is not sufficient. Educational value depends on whether these objectives are translated into meaningful game mechanics, decision structures, feedback loops, and opportunities for reflection (Arnab *et al.*, 2015). These findings indicate that DSGs are especially suitable for teaching competencies that require learners to connect analytical reasoning with strategic judgement under conditions of uncertainty. Not all games represent stakeholder perspectives, soft skills, or multidimensional consequences of decisions to the same extent. Future DSGs should therefore move beyond a narrow focus on financial or operational indicators and include feedback mechanisms that make process-related, technical, and organizational consequences visible. This finding resonates with the concept of serious games as 'reality-changing methods' (Sun and Zhang, 2025). Their participatory design study demonstrates that effective game design goes beyond simulation by translating complex system dynamics into experiential learning environments, thereby changing how participants perceive and act within real-world systems. A limitation is the small and highly specialized sample of five DSGs in a healthcare management context, which limits the transferability of the findings to other DSGs and educational contexts. In addition, the games were identified through an open-ended web search and access to available providers, meaning that unpublished, institution-specific, non-commercial, or non-English-language games may not have been included.

The study focused on game characteristics and design patterns rather than on learner experiences or long-term competency development. Moreover, the identification and assignment of LOs in the comparison matrix were constrained by the availability, scope, and level of detail of provider-supplied information and other publicly available sources. The study therefore did not examine whether learners achieved the identified LOs. The binary presentation in Table 2 merely captures whether LOs are addressed, but it does not allow for any conclusions regarding the depth or quality of its didactic implementation. Future research should investigate how competency requirements for healthcare managers can be systematically translated into observable and measurable LOs and subsequently aligned with DSG design decisions. Because the current study solely evaluates the formal presence of specific design and learning characteristics, the actual pedagogical effectiveness remains unexamined. Consequently, empirical effectiveness studies are needed to examine whether the proposed DRs are associated with improved learning outcomes, particularly competency development, learner engagement, and strategic decision-making.

6. Conclusion

This study provides a structured basis for analyzing and informing the design of DSGs in healthcare management education. By comparing five DSGs, it identified recurring design patterns and relevant differences in how LOs, decision-making structures, feedback mechanisms, resource constraints, and healthcare-specific complexity are represented in educational settings. The resulting DRs offer an initial orientation for educators and game developers seeking to derive and refine design decisions aligned with competency-oriented LOs. Therefore, the findings point to the importance of multi-role structures, flexible strategic decision-making, multidimensional feedback, explicit resource limitations, and the representation of process-related, technical, and organizational consequences. In this way, the study contributes to translating insights from existing DSGs into more concrete design considerations for future competency-oriented DSGs in healthcare management.

Data Availability Statement

The full dataset can be viewed on the website (SMiLeH - Comparison Matrix, 2026) or is available from the author upon request.

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Ethics Declaration

All listed providers gave written informed consent and agreed to the use and publication of the collected data and textual interpretations for research purposes.

AI Declaration

DeepL was used to improve the language and grammar. Gemini was used to structure texts and adapt them to citation guidelines. Elicit and Perplexity were used to assist with literature reviews.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Author Contributions

TH: Conceptualization, Formal analysis, Writing – Original draft. AH: Methodology, Writing – Review & Editing. GO: Writing – Review & Editing. UB: Writing – Review & Editing. JDL: Conceptualization, Supervision.

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