



**HELLENIC MEDITERRANEAN UNIVERSITY
SCHOOL OF MANAGEMENT AND ECONOMICS
SCIENCE
DEPARTMENT OF MANAGEMENT SCIENCE AND
TECHNOLOGY**

**MSc in
MANAGEMENT AND DIGITAL TRANSFORMATION**

**Exploring serious games aiming to enhance
hospital personnel healthcare management
knowledge and administrative skills
acquisition: A systematic review**

MASTER THESIS

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**ΠΡΟΓΡΑΜΜΑ ΜΕΤΑΠΤΥΧΙΑΚΩΝ ΣΠΟΥΔΩΝ
«ΔΙΟΙΚΗΣΗ ΚΑΙ ΨΗΦΙΑΚΟΣ ΜΕΤΑΣΧΗΜΑΤΙΣΜΟΣ»**

**Διερεύνηση παιχνιδιών σοβαρού σκοπού με στόχο
την ενίσχυση των γνώσεων μάνατζμεντ
υπηρεσιών υγείας και την απόκτησης διοικητικών
δεξιοτήτων του προσωπικού των νοσοκομείων:
Μια συστηματική ανασκόπηση**

ΔΙΠΛΩΜΑΤΙΚΗ ΕΡΓΑΣΙΑ

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Disclaimer: *I certify that I am the author of this master's thesis and that any assistance I have received during its preparation is fully acknowledged. I have also cited all the sources of information and quoted any ideas or words used, whether they were directly quoted or paraphrased. I also certify that this master's thesis was prepared by me to fulfill the requirements for the Management and Digital Transformation Master's Program degree appointed by the Department of Management Science and Technology of HMU.*

Υπεύθυνη Δήλωση: *Βεβαιώνω ότι είμαι συγγραφέας αυτής της διπλωματικής εργασίας και ότι κάθε βοήθεια την οποία είχα για την προετοιμασία της, είναι πλήρως αναγνωρισμένη και αναφέρεται στη διπλωματική εργασία. Επίσης έχω αναφέρει τις όποιες πηγές από τις οποίες έκανα χρήση δεδομένων, ιδεών ή λέξεων, είτε αυτές αναφέρονται ακριβώς είτε παραφρασμένες. Επίσης βεβαιώνω ότι αυτή η διπλωματική εργασία προετοιμάστηκε από εμένα προσωπικά ειδικά για τις απαιτήσεις του Μεταπτυχιακού Προγράμματος Σπουδών Διοίκηση και Ψηφιακός Μετασχηματισμός του Τμήματος Διοικητικής Επιστήμης και Τεχνολογίας του ΕΛΜΕΠΑ.*

ABSTRACT

Serious games, either in digital or analog form, are pedagogic tools aiming to serve educational or informative purposes by incorporating fun aspects of games with serious elements of learning. Serious games are an emerging trend in medical and nursing education since they provide the ideal opportunity to increase knowledge and enhance decision-making and problem-solving skills by actively involving learners. However, serious game initiatives on hospital management education have been given less attention. Robust search algorithms were developed and implemented in the most pertinent scientific databases (Scopus and Pubmed) to summarize relevant articles published in the past vicennium. A total of 892 results were obtained and, upon removing duplicates, 810 studies were screened. Overall, 34 relevant studies were identified, while two more publications were included via snowballing technique. Altogether, 36 different serious games with over 1700 participants emerged with half of them being digital (50.0%) and half of them analog (50.0%). As regards the game design, 63.9% were multiplayer games, while 44.4% required team collaboration. Serious games' main learning target was categorized according to Katz's three-skill approach for effective administration including technical (38.9%), interpersonal (5.5%), and conceptual (55.6%) skills acquisition. Serious game learning activity type (categories=4), teaching subject (themes=6), and geographical distribution (countries=19) were also explored. This systematic review aimed to stimulate interest and increase awareness of using serious games to enhance hospital personnel's knowledge and skills in managerial roles and administrative processes. Furthermore, it aimed to inspire academics, healthcare stakeholders, and policymakers to convey administrative skills and basic management concepts to a wide variety of hospital employees by utilizing means and methods of game-based learning.

Key Words: serious games; game-based learning; educational games; hospital administration; hospital financial management; health services management; systematic review

ΠΕΡΙΛΗΨΗ

Τα παιχνίδια σοβαρού σκοπού, είτε σε ψηφιακή είτε σε αναλογική μορφή, αποτελούν εκπαιδευτικά εργαλεία που στοχεύουν σε παιδαγωγικούς ή ενημερωτικούς σκοπούς συνδυάζοντας διασκεδαστικές πτυχές των παιχνιδιών με σοβαρά στοιχεία της μάθησης. Τα παιχνίδια σοβαρού σκοπού αποτελούν μια αναδυόμενη τάση στην ιατρική και νοσηλευτική εκπαίδευση, καθώς παρέχουν ιδανικές συνθήκες προαγωγής της γνώσης και ενίσχυσης των δεξιοτήτων λήψης αποφάσεων και επίλυσης προβλημάτων μέσω της ενεργούς συμμετοχής των εκπαιδευόμενων. Ωστόσο, η ανάπτυξη παιχνιδιών σοβαρού σκοπού στον τομέα του μάνατζμεντ υπηρεσιών υγείας δεν έχει λάβει ιδιαίτερης προσοχής μέχρι σήμερα. Στο πλαίσιο της παρούσας συστηματικής ανασκόπησης, αναπτύχθηκαν συνεκτικοί αλγόριθμοι αναζήτησης και εφαρμόστηκαν στις δυο πιο ενδεδειγμένες επιστημονικές βάσεις δεδομένων (Scopus και PubMed) για να συγκεντρώσουν σχετικά άρθρα που έχουν δημοσιευθεί την τελευταία εικοσαετία. Συνολικά εξήχθησαν 892 αποτελέσματα και, κατόπιν αφαίρεσης διπλοτύπων, ελέγχθηκαν 810 μελέτες. Στο τελικό δείγμα συμπεριλήφθηκαν 34 σχετικά άρθρα, ενώ προστέθηκαν δύο ακόμη δημοσιεύσεις χρησιμοποιώντας τη μέθοδο της χιονοστιβάδας (snowballing technique). Συνολικά, προέκυψαν 36 διαφορετικά παιχνίδια σοβαρού σκοπού από τα οποία το 50% ήταν ψηφιακά και το 50% αναλογικά. Όσον αφορά το σχεδιασμό των παιχνιδιών, το 63.9% ήταν παιχνίδια πολλαπλών παικτών (multiplayer games), ενώ το 44,4% απαιτούσε και τη συνεργασία μεταξύ των παικτών. Ο κύριος μαθησιακός στόχος των παιχνιδιών σοβαρού σκοπού ταξινομήθηκε σύμφωνα με το μοντέλο των τριών δεξιοτήτων για αποτελεσματική διοίκηση του Katz, το οποίο περιλαμβάνει την απόκτηση: τεχνικών (38.9%), διαπροσωπικών (5.5%) και διανοητικών/κριτικών (55.6%) δεξιοτήτων. Επιπρόσθετα πραγματοποιήθηκε ταξινόμηση ως προς τον τύπο των παιχνιδιών σοβαρού σκοπού (κατηγορίες=4), τη θεματολογία τους (κατηγορίες=6) και τη γεωγραφική τους κατανομή (χώρες=19). Η παρούσα συστηματική ανασκόπηση αποσκοπεί να προκαλέσει το ενδιαφέρον και να αναδείξει τη δυνατότητα χρησιμοποίησης των παιχνιδιών σοβαρού σκοπού για τη βελτίωση των γνώσεων και την ενίσχυση των δεξιοτήτων των εργαζομένων που αναλαμβάνουν διευθυντικούς ρόλους και διοικητικά καθήκοντα στα νοσοκομεία. Επιπλέον, στοχεύει να εμπνεύσει ακαδημαϊκούς και φορείς χάραξης πολιτικών υγείας για την υιοθέτηση πρακτικών μάθησης που βασίζονται στο παιχνίδι με σκοπό τη βελτίωση των διοικητικών δεξιοτήτων και τη μετάδοση βασικών εννοιών του μάνατζμεντ σε ένα εύρος εργαζομένων στα νοσοκομεία.

Λέξεις Κλειδιά: παιχνίδια σοβαρού σκοπού, μάθηση μέσω παιχνιδιών, εκπαιδευτικά παιχνίδια, διοίκηση νοσοκομείων, οικονομική διαχείριση νοσοκομείων, μάνατζμεντ υπηρεσιών υγείας, συστηματική ανασκόπηση

This work is dedicated to those who make mistakes, those who resist, those who believe in miracles, and above all, those who know that the most important thing is not what you are, but what you choose to be.

Cheers to pursuing your dreams!

Inspired by Fauve's lyrics in "Blizzard"

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ABBREVIATIONS

Emergency Department (ED)

Information Technology (IT)

Operational Research and Management Science (ORMS)

Role-Playing Games (RPGs)

Science, Technology, Engineering and Math (STEM)

United Kingdom (UK)

United States of America (USA)

Virtual Reality (VR)

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Gratitude to all and each one of you.

CHAPTER 1

INTRODUCTION

The daily working life of hospital executives and healthcare professionals assigned administrative duties and managerial roles resembles a lot a series of game-like challenges. They should be able to determine strategies and predict outcomes similarly to chess players, develop tactics and perform bluffs like poker experts, and act as cooperative team players to improve organizations' productivity and outcomes (Dowd & Root 2003). But what if game-based learning could actually be used to enhance hospital management knowledge and experiences and increase administrative skills acquisition?

1.1 Literature review

Literature indeed supports that game-based learning, including serious game utilization, strongly impacts learner motivation and cognitive outcomes making it a powerful motivation driver (Schrader 2022). More specifically, according to a popular definition by Alvarez, serious games serve educational or informative purposes by blending serious elements of learning, with playful and fun aspects of gaming capitalizing on the innate human inclination to play by also incorporating game mechanisms into the learning experience (Alvarez & Djaouti 2012). Serious games are proven to be effective pedagogical tools, especially compared to conventional educational methods (Barnabè et al. 2017) and gamification has long been used in disciplines like science to enrich teaching experience, boost information transfer, and increase learner involvement (Kalogiannakis et al. 2021).

Along this line, serious games and game-based learning have become a flourishing trend in healthcare professionals' education (van Gaalen et al. 2021). Numerous systematic reviews report on serious games being developed and implemented in the medical and nursing field (Arif et al. 2024; Chatzea et al. 2024; Wang R et al. 2016;) since they provide learners the perfect opportunity to increase knowledge, enhance decision-making and problem-solving skills, and gain valuable practical experience in risk-free environments (Wang et al. 2022; Sorge et al. 2021). However, serious game initiatives on hospital management education have been given less attention, although it has been reported that they can be powerful training and

management development tools for improving team performance, enhancing resource allocation skills, and increasing leadership abilities in hospital personnel (Barnabè et al. 2017).

- According to the above, within healthcare organizations, serious games can be seen as alternative management tools designed to address challenging administrative issues by utilizing gaming experiences to simulate realistic scenarios and reflect real-life work situations (Khelladi et al. 2023). This is particularly useful considering that healthcare managers are frequently acting at the complex interface of conflicting objectives such as ensuring high-quality care, promoting employee well-being, and fulfilling efficiency needs and political regulations. To this end, serious games enable healthcare managers and hospital executives to put different decisional options to the test, experience their potential outcomes, and hence strengthen strategic planning abilities and successful decision-making processes in practice (Sorge et al. 2021).

1.2 Research hypothesis

Given the numerous advantages of serious games for learners in multiple educational areas, the research hypothesis of this thesis aimed to explore whether serious games targeting to enhance hospital personnel healthcare management knowledge and administrative skills acquisition have increased during the past years and if the modern technological advancements along with the COVID-19 pandemic have forced the digitization of healthcare management serious games. According to our observations in other health-related fields that utilize serious games along with the literature indicators, we are expecting to find an increased number of hospital management serious games, as well as a higher percentage of digital serious games (compared to analog games).

In order to collect all the necessary information to test our research hypothesis, we have formed four specific research questions that will enable us to guide our research methodology more effectively by breaking down all the necessary requirements to provide clear and concise scientific results. The research questions were shaped to approach the hypothesis holistically and can be found within the methods section of the present thesis in Chapter 5 (page 11).

1.3 Aim and research significance of the thesis

This systematic review was inspired by a previous extensive review conducted fifteen years ago by Kraus and colleagues on hospital management games from an operations research perspective (Kraus et al. 2010). The master thesis aimed to update Kraus review by examining the potential advances in the field within the past twenty years, exploring the extent of serious game digitalization, and stimulating interest in utilizing serious games to enhance hospital personnel's knowledge and skills in managerial roles and administrative processes.

The overall objective was to provide useful insights by summarizing all the available information in the literature, to motivate academics and healthcare policy makers or stakeholders to convey administrative skills and basic management concepts to a wide variety of hospital employees and healthcare students through game-based learning. Its significance lies within the fact that serious games are a new educational medium that holds two very prominent virtues: learning and engagement (Speelman et al. 2023). Serious games can transform management education, beyond traditional teaching, to a more advanced, effective and satisfactory learning since they offer the perfect tool to enrich curriculum activities and life-long learning training seminars.

Hence, this thesis aimed at locating serious games initiatives implemented around the globe, to showcase good paradigms of hospital management serious games that could be developed even with scarce or limited resources. The overall purpose was to inspire countries, like Greece and other counterparts, who have not yet incorporated serious games in healthcare management training, to invest in their implementation and reap the multiple benefits that they offer.

Embracing serious games as hospital management educational tools, is also considered of major importance considering that they can make healthcare management education creative and innovative for academics, more attractive and engaging for learners, high-quality for the patients and cost-effective for the overall healthcare system since they can contribute in forming more qualified and high-performing hospital executives within limited time, efforts and resources.

CHAPTER 2

DEFINITIONS AND TERMINOLOGY

2.1 Games

Games have a long history; the first games were war-themed games played in China and India in 3000 BC and 1000 BC, respectively, while in the 17th and 18th centuries chess became popular. During the 19th century, games employed charts, tables, and calculations, while random effects were also included by using dice. During World War II, the operations research field emerged in the United Kingdom (UK) to optimize war-related strategic and logistic problems (Kraus et al. 2010). Operations research problems involve various decision makers (players) facing an allocation problem; the main interplay subject of operations research games revolves around resource optimisation and allocation (Borm et al. 2001).

According to the above and within centuries of games history, it is needless to say that academics have defined the concept of ‘game’ in several different ways over the years (Stenros 2022). However, in the beginning of the 1970s scholars in the gaming field agreed on what the definition of “game” should be. Proposed by Clark Abt in 1968, games were defined as “any contest (play) among adversaries (players) operating under constraints (rules) for an objective (winning, victory pay-off)” (Ellington et al. 1982).

Today, it seems that two are the main definitions that demarcate the field of game studies (Stenros 2022); the first was supplied by Salen Tekinbaş & Zimmerman in 2004, while the second was introduced by Juul in 2005:

- A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome (Salen Tekinbaş and Zimmerman 2004).
- A game is a rule-based system with a variable and quantifiable outcome, where different outcomes are assigned different values, the player exerts effort in order to influence the outcome, the player feels emotionally attached to the outcome, and the consequences of the activity are negotiable (Juul 2005).

Both of these terms are cluster definitions, meaning they offer a list of criteria and the more the criteria apply to the case, the more it qualifies to be defined as a ‘game’.

2.2 Game-based learning

Game-based learning has a long prehistory since games have been used for thousands of years in educational contexts such as strategic training and tactical thinking, as well as learning tools for language skills improvement and mathematics comprehension; to this line, there are several examples of how games have been used to educate princes, military officers and politicians even from the era of ancient Greece and during the Roman Empire rise (Hellerstedt & Mozelius 2019).

The history of analogue games for teaching and learning are dated back to the seventh century with chess being one of the most popular board games that was used to enhance strategic decision making and logical thinking in military executives (Jaiswal 2021). In the modern era, game-based learning was introduced as a pedagogical approach at university level during the 1970s, while nowadays the new trend in game-based learning are digital games with a wide variety of game genres and gaming platforms introduced as a way of individualisation in modern mass education (Hellerstedt & Mozelius 2019).

Most definitions of game-based learning emphasize that it is a type of game play with predefined learning outcomes (Shaffer et al. 2005). Nowadays, many definitions assume that the defined game is a digital game, but this is not always the case (Plass et al. 2015). Generally, the design process of games for learning involves balancing the need to cover the subject matter with the desire to prioritize game play (Plass et al. 2010) whether they are designed as analogue or digital games. Simply put, game-based learning can be defined as “learning that is facilitated by the use of a game” that can be addressing any academic level to lifelong learning, including a range from simple memorization games to games targeting high-level learning outcomes. The game can be intrinsic or supplemental to other learning methods, played face-to-face with physical objects or electronically via computer or other digital devices (Whitton, 2012).

2.3 Serious games

Game-based learning incorporates the use of serious games (Schrader 2022). The two terms can be often mentioned in the literature as synonymous, however game-based learning is an approach referred to teaching in educational contexts (Becker 2021). To this line, serious games are perceived as educational tools of game-based learning, which aim to enhance a

specific learning goal by transforming a learning task into a distinct game to make learning more interesting and effective (Schrader, 2022).

The term “serious games” has a long tradition that likely started from the 1970 monograph of Clark Abt entitled “Serious games”. In this book, Abt defines serious games as “games that have an explicit thought-out educational purpose and are not intended to be played primarily for amusement” (Cosimini et al. 2022). Till today, several definitions for serious games have been introduced varying according to the different perspectives and purposes that they were developed to explain (Susi et al. 2007). A brief overview of the literature reveals that no consensus on serious games definition prevails, however, for the purposes of this master thesis, the term “serious game” as defined by Alvarez will be adopted: “educational application, whose initial intention is to combine, coherently and at the same time, serious aspects, in a non-exhaustive and non-exclusive way, teaching, learning, communication, or even information with the fun aspects of games” (Billebot et al. 2018).

Serious games were developed initially mostly for classes related to science, technology, engineering and math (STEM) where they were thought to have a particularly high potential for overcoming deficiencies of traditional lectures. However today serious games in the form of digital or analogue games are included in various contexts such as healthcare and medicine, military training, business management, engineering, and of course, education (Madani et al. 2017; Michael & Chen 2006).

2.4 Gamification

Finally, it is important to not confuse the term “gamification” with serious games. The term "gamification" was coined by Nick Pelling, a game developer and programmer in 2002 that tried to endorse playful elements to computer hardware (Sharma & Sharma 2023; Khaitova 2021). Gamification can be briefly described as using game design elements in non-game environments (Deterding et al. 2011). Gamification uses only a few game elements, such as receiving awards for tasks and overcoming challenges to get points, rather than developing an entire distinct game (Stiller & Schworm 2019). Hence, gamification is considered that is conceptually more similar to game design, rather than actually serious games development (Landers et al. 2018). Use of gamification in education is usually limited in game mechanics such as point awarding, leaderboards, and badges (Fischer et al. 2016).

CHAPTER 3

SERIOUS GAMES COMPONENTS

1.3.1 Serious games characteristics

Game-based learning and serious games both include characteristics that are commonly used to define traditional games. Among the most frequent characteristics are (Schrader et al. 2022; Garris et al. 2017; Whitton 2012; Graesser et al. 2009):

- containing a story narrative with characters that involve the players,
- constructing competitive setting with a clearly defined goal to challenge the players,
- creating an interactive nature which allows game's story to only evolve through interaction with the player's behavior, and
- setting clear rules by introducing instructions and constraints of the game that describe how it should be played

Similarly to the above, the following diagram (Figure 3.1) summarizes the distinct components that are usually observed in serious games including: 1) rules/gameplay, 2) challenges, 3) interaction modes, and 4) goals. The gameplay is described as the pattern defined through the game rules which connects the player to the game. The goals may be explicit (stated as game objectives) or implicit (implicit goals may include increasing skills and abilities, gaining knowledge or acquiring experience) (Wattanasoontorn et al. 2013).

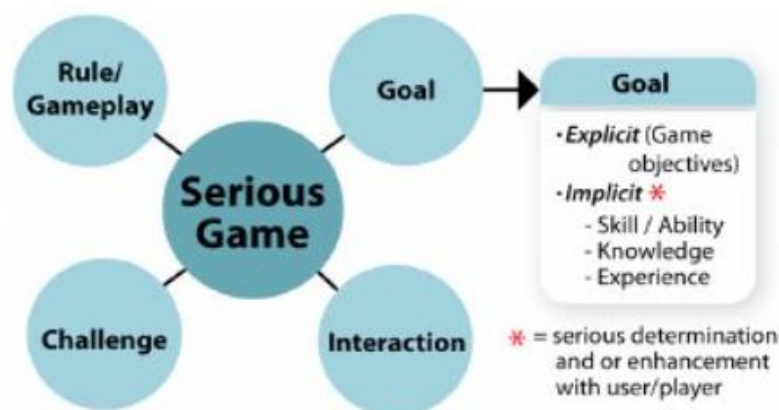


Figure 3.1. Serious games components (Wattanasoontorn et al. 2013)

Furthermore it is important to highlight that serious games' basic features go beyond the triptych of “challenge, play and fun” since those components may not be the main purpose for several serious games. On the contrary, for many serious games it is more appropriate to talk about a game experience rather than an entertaining game since their main objective is to provide emotion and convey meaning by being thought-provoking, informative, awareness-raising and stimulating for the learners (Marsh 2011).

1.3.1 Serious games types

There are several ways to define serious games types including purpose-based classifications, scope categorization and setting gameplay criteria and game structure groups (Djaouti et al. 2019). However, the most popular classification is based on the game story, which means distinguishing the game type according to the description of the game play; to this end, serious games can be classified into broad thematic categories such as the brief list following: action games, adventure games, puzzle games, quizzes, role playing games, simulation games and strategy games (Grace 2005). In addition to the above classification that is most frequently used for digital games categorization, an additional game type - board games - should not be forgotten (Yu et al. 2022).

Among the most popular serious game types according to the literature are quizzes and simulations (Riemer & Schrader 2015). Quizzes are the simplest type of serious games that tests already acquired knowledge while competing with others or a gaming system (Granic et al 2014). In contrast, simulations are more complex by allowing learners to handle real word events requiring players to execute and transfer knowledge and problem solving strategies by experimenting (Riemer & Schrader 2015). Furthermore, role-playing games (RPGs) are one of the primary game genres providing the player with a character that develops through the play experience (Drachen et al. 2009). Finally, by board games we mean all analog games played on a table (Sousa & Bernardo 2019) that typically use pieces including miniatures, cards, dice, etc.

However there is a plethora of other serious games types that keep increasing since the advancements in the gaming field (especially in digital gaming) are constantly evolving. Some examples include escape rooms (virtual or in vivo), platform games, rhythm games (music games) and many more.

CHAPTER 4

SERIOUS GAMES EDUCATIONAL BENEFITS

Taken into consideration the diversity of its applications and its multiple educational objectives, serious games are learning tools that target all age groups, are not limited to training, and may be used to enhance educational purposes; to this line learning via serious game has several educational benefits based on learning concepts advocated by constructivist psycho-cognitive theories which guarantees learners' intrinsic motivation, spawn cognitive conflicts and allows situational learning (Mouaheb et al. 2012).

Indeed, the success of learning via serious games is based on the actual involvement of the participant who is playing the serious game, which in turn, creates cognitive links with real-life situations that enable the learner to develop relevant associations and to exploit mnemonic strategies with the facilitation of multi-dimensional educational aids (for example visual and/or auditory) (Ypsilanti et al. 2014). Hence, the beneficial aspects of learning using serious games can be mostly attributed to the elevation of numerous cognitive skills (such as visuo-spatial abilities, memory and motor skills), which are directly or indirectly involved in the process of learning.

As expected, a systematic review and a meta analysis have proven that serious games improve the acquisition of knowledge and cognitive skills and are more effective in terms of learning and retention of knowledge compared to conventional teaching methods (Wouters et al. 2013; Wouters et al. 2009). Furthermore, it has been revealed that learners utilizing serious games acquired more knowledge when the game was used supplementary with other instruction methods, when multiple training sessions were performed, and when learners worked in groups of teams (Wouters et al. 2013).

It is also bibliographical proven, that serious gaming can produce a wide range of educational benefits depending mainly on how they are used and secondly on the ultimate goals of the person playing the game (Schijven and Kikkawa, 2023). The main benefits brought to the education context by serious games implementation include skills training and development, the greater involvement of the students in class projects and their application in a real context. Therefore, the potential of these tools is evinced in offering a more innovative and immersive training to the learners (Almeida & Simoes 2019).

Additionally, according to the results of a meta analysis, serious games are very effective in improving educational outcomes, facilitating holistic understanding of scientific concepts, enhancing cognitive abilities, increasing positive effect of learning, improving teaching experience and increasing learners' overall satisfaction. Furthermore, serious games enhance social skills such as facilitating socio-cultural learning in terms of cognitive and motivational effects and team opinions, improving communication competence and increasing collaboration (Zhonggen, 2019).

As regards serious games developed to enhance management field skills, literature supports that they can offer several advantages including experiencing the effects of choosing among decision-making alternatives, developing a shared perspective of a problem, facilitating mutual understanding, and enhancing team-building within a group of people with different backgrounds (Brandl et al. 2010; Bochennek et al. 2007; Dieleman & Huisingh 2006). Along this line, it is supported that serious games can have a significant impact on the behavior and culture of the employees in the work environment (Shahri et al. 2019).

Furthermore, serious games can turn employees' life-long training into amusing and relaxing experiences (Larson, 2020) by transforming long, boring training meetings into fun activities that enthuse and motivate learners while encouraging socialization and open expression of concerns (Tews et al. 2014). In this manner, serious games can help evaluate and correct participants' reactions to certain situations, point out potential mistakes and misconducts in a fun and encouraging manner, and provide opportunities for improvement that lead employees to adopt best practices and overcome their limits (Köse et al. 2019).

Therefore, although the most widespread use of serious games is in the transmission of knowledge by enabling learners to acquire knowledge and skills and pass them on from one generation to another or from experts to beginners (Allal-Chérif et al. 2022), serious games are also important tools for enhancing work ethics and values, integrating new employees, improving overall performance, and creating a sense of belonging and a willingness to progress within the work organization (Taylor et al. 2012).

To conclude, the added value of serious games can be observed in multiple aspects of an organization's operations, therefore, implementing serious games in healthcare management field is crucial given that hospitals are complex and stressful work environments with employees experiencing high burnout rates, who could benefit the most from the significant advantages that serious games have to offer, as they are reported above.

CHAPTER 5

METHODS

A systematic literature review on studies developing and implementing serious games to enhance hospital personnel's knowledge and skills in managerial roles and administrative processes was conducted in the PubMed and Scopus databases. The four research questions that guided the systematic review included the following:

Question 1: How many serious games in the hospital management field have been developed and implemented in the past twenty years? Are digital serious games more common than analog serious games?

Question 2: Are hospital management serious game initiatives spread evenly around the globe? Is any country a leader in the field?

Question 3: What types of serious games are most commonly implemented? What are their main gameplay characteristics?

Question 4: What are the most common educational subjects of the emerged serious games? Which hospital management skills do they most often try to enhance?

To form the search algorithms that would answer the above research questions, we investigated keywords used in relevant studies and algorithms implemented by similar review articles. Keywords focused on two main categories: 1) hospital management and healthcare administration-related key terms and 2) serious games and game-based learning search terms. As a result, three robust search algorithms were implemented: two in Scopus (technical/multidisciplinary database) and one in PubMed (health-specific database). The PubMed search algorithm utilized the most relevant mesh terms along with other common keywords. resulting in the following search algorithm: ("hospital administration"[MeSH Terms] OR "Personnel Administration, Hospital"[MeSH Terms] OR "Financial Management, Hospital"[MeSH Terms] OR "healthcare manage*"[Title/Abstract] OR ("health care manage*"[Title/Abstract] OR ("healthcare administrat*"[Title/Abstract] OR ("health care administrat*"[Title/Abstract] OR "hospital manage*"[Title/Abstract])) AND ("Games, experimental"[MeSH Terms] OR "Video Games"[MeSH Terms] OR "Gamification"[MeSH Terms] OR ("serious game*"[Title/Abstract] OR "game*"[Title/Abstract])).

In the Scopus database, a high-precision search algorithm was first implemented utilizing four basic key terms and examining only the titles of the articles. According to the above, the search algorithm formulated was: (TITLE (game*) AND TITLE (health AND care) OR TITLE (healthcare) OR TITLE (hospital*)) AND PUBYEAR > 2002 AND PUBYEAR < 2024 AND (LIMIT-TO (LANGUAGE, "English")).

Furthermore, we created a supplementary broader search algorithm to locate relevant studies that didn't emerge from the first algorithm. The second search algorithm utilized a plethora of related keywords to provide a broader review of the literature. Hence, the supplementary search algorithm created was the following: TITLE-ABS-KEY (("serious gam*" OR "online gam*" OR "computer gam*" OR "computer-based gam*" OR "mobile gam*" OR "web-based gam*" OR "game-based" OR "game based" OR "digital gam*" OR "digital games" OR "gamif*" OR "video gam*" OR "virtual gam*" OR "videogam*" OR "edugam*" OR gaming OR game*) AND ("hospital* manage*" OR "hospital* administrat*" OR "healthcare manage*" OR "health care manage*" OR "healthcare financ*" OR "health care financ*" OR "hospital financ*" OR "healthcare administrat*" OR "health care administrat*" OR "clinical operation manage*")) AND PUBYEAR > 2002 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "re") OR LIMIT-TO (DOCTYPE , "cp") OR LIMIT-TO (DOCTYPE , "ed") OR LIMIT-TO (DOCTYPE , "cr")) AND (LIMIT-TO (LANGUAGE , "English")).

Among the inclusion criteria set were the following: publish period from 2003 to 2023, English language, studies categorized as articles/reviews/conference papers/conference reviews/editorial doctype (in the supplementary algorithm of Scopus), and studies developing and/or implementing serious games to be used for hospital management/administration knowledge and skills acquisition. The main exclusion criteria included: studies focusing on game theories without developing serious games, studies introducing serious games aiming to enhance hospitals' personnel care provision skills, and studies that were not retrieved in full-text form.

A three-step process was followed to screen the eligible articles. Initially, the relevance of the studies was examined according to their title. Consequently, the abstracts were screened to select studies of interest. Finally, the article's full text was reviewed to determine the included studies. Figure 5.1 describes the undertaken methodological steps (flow diagram according to PRISMA guidelines) which demonstrates the systematic review process in numbers per stage

(Page et al. 2021). Overall, 892 articles emerged from the search algorithm, and upon a thorough review, 34 studies were finally included according to the inclusion and exclusion criteria. Furthermore, two more relevant publications were included via the snowballing technique. Finally, two studies were excluded due to full-text unavailability.

The most common reasons for exclusion per stage included:

- 1) Title screening: non-relevance, study design type (literature review), using the word game as idioms/expressions in title, unfitting participants (mostly patients)
- 2) Abstract reviewing: non-relevance, unfitting participants (patients), games aiming to enhance hospitals' personnel healthcare provision skills (managing diseases, treating patients, medication, etc.), studies reporting on game theories without developing a serious game
- 3) Full text screening: unable to retrieve full-text (n=2), games not aiming to enhance managerial/administrative skills (e.g. patients communication), studies reporting on game theories without developing a serious game

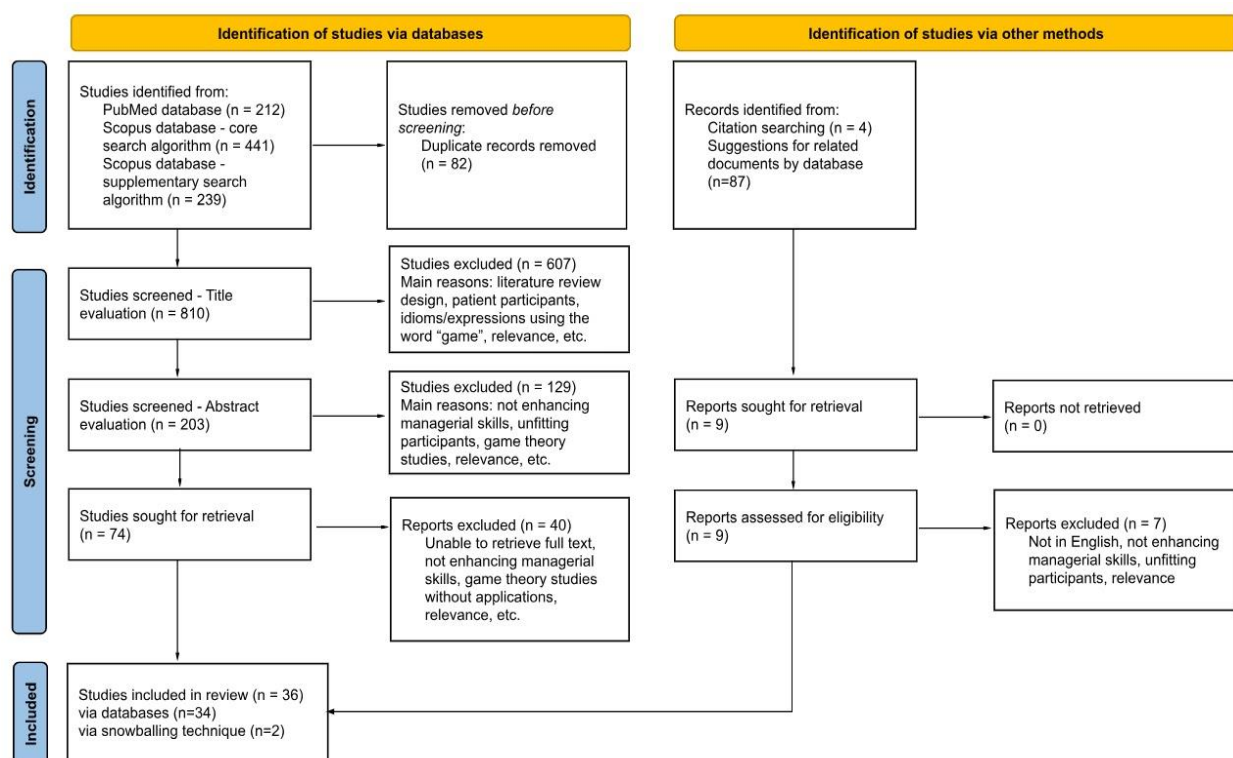


Figure 5.1. Study selection flow diagram (according to PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and other sources)

CHAPTER 6

RESULTS

Overall, 36 studies were included in the final review (Pavillet & Dumas 2023; Martin 2022; Höffner et al. 2022; Schwengel et al. 2022; Hiragi et al. 2022; Bacelar-Silva et al. 2021; Rahouti et al. 2021; Pulido et al. 2021; Hiragi et al. 2020; Tan et al. 2020; Zhang et al. 2020; Zhang 2019; Douglas et al. 2019; Bach et al. 2018; Lovreglio et al. 2018; Ghazvini & Shukur 2018; Barr-Walker & Nevels 2018; Thornton Bacon et al. 2018; Vithanage et al. 2017; Jantana et al. 2016; Gradel et al. 2016; Huyghe et al. 2016; Ruggiero 2016; Cheong & Lim 2016; Chalk & Manzi 2016; Gaynor et al., 2016; Shi et al. 2015; Guérin et al. 2015; Ribeiro et al. 2013; Basole et al. 2013; Takemura et al. 2013; Broberg & Edwards 2012; Bregman et al. 2009; Rauner et al. 2008; Uhles et al. 2008; Levi & Bregman 2003).

The main characteristics of the identified studies (first author, publication date, title, game type, game short description, aim of the game, and reference) are listed in Table 6.1. The majority of them (77.8%, n=28) were published during the past decade, while altogether, more than 1,700 participants were enrolled. Participants number derived from 26 studies that clearly stated the study sample. Enrolled participants were mostly hospital personnel (50.0%, n=18) or health-related students, and students in management, informatics, and other disciplines (33.3%, n=12). A 16.7% (n=6) included a varied study sample of hospital personnel, academics, researchers, students, healthcare managers, and policymakers. To estimate the overall sample size, we excluded studies that: 1) didn't provide a clear participant number (Pavillet & Dumas 2023; Martin 2022; Gaynor et al. 2016; Bregman et al. 2009; Rauner et al. 2008), 2) enrolled hospital personnel, patients, and community members without separating the number of participants in each group (Barr-Walker & Nevels 2018), and 3) didn't mention being pilot tested (Bach et al. 2018; Ribeiro et al. 2013; Levi & Bregman 2003). According to the above, the number of participants was estimated at 1,772.

Regarding the term “serious games”, it is of note that 63.9% (n=23) of the included studies didn't mention it at all in their manuscripts. Only 16.7% (n=6) of the articles were characterized as “serious games” in their title, while a further 13.9% (n=5) included the term “serious games” in their keywords. Finally, 5.5% (n=2) of the articles mentioned the word “serious game” within their text.

Table 6.1. Summary of studies included in the systematic review

Author(s)	Year	Title	Game type	Game short description ¹	Aim of the game ¹
Pavillet & Dumas	2023	The use of games as an innovative prevention method for discussing work with hospital healthcare staff	analog analog	card game (Dixit®) and board game (Concept®)	rebuild staff bonds by encouraging work discussion and diverting conflict and tensions
Martin	2022	The Price Is Right: Introducing Health Care Costs Through Gameful Learning	analog	“One Bid game” from the show “The Price Is Right”	increase knowledge by guessing the cost of common nursing materials and procedures
Höffner et al	2022	SNIK Quiz: A Multiple Choice Game About Information Management in Hospitals	digital	browser game with multiple-choice questions	enhance knowledge of information management in hospitals
Schwengel et al	2022	Influx! A game-based learning tool for in-hospital interprofessional disaster preparedness and response	analog	collaborative board game (Influx!)	prepare intra-hospital workers to function in teams during disasters
Hiragi et al	2022	Token Economy-Based Hospital Bed Allocation to Mitigate Information Asymmetry: Proof-of-Concept Study Through Simulation Implementation	digital	simulation game based on a token economy-system	improve resource management skills and human resources satisfaction
Bacelar-Silva et al	2021	Identifying and Addressing the Underlying Core Problems in Healthcare Environments: An Illustration Using an Emergency Department Game	analog	Emergency Department (ED) - board game	improve patient flow in the ED by making better use of the system’s existing resources
Rahouti et al	2021	Prototyping and Validating a Non- immersive Virtual Reality Serious Game for Healthcare Fire Safety Training	digital	non-immersive Virtual Reality (VR) simulation game	VR-based training for healthcare fire safety education
Pulido et al	2021	Security Awareness Level Evaluation of Healthcare Participants Through Educational Games	analog	Lego-based designed board game	enhance information security awareness of healthcare personnel
Hiragi et al	2020	Preliminary Evaluation of Market Mechanism-Based Bed Allocation System	digital	game-like simulation token system	bed allocation applying market mechanism and human resource allocation
Tan et al	2020	Health\$en\$eTM: Developing a Board Game on Value-based Healthcare Financing	analog	competitive board game (Health\$en\$eTM)	improve knowledge of healthcare finance by optimizing healthcare expenditure
Zhang et al	2020	Serious Gaming of Logistics Management in Pediatric Emergency Medicine	digital	VR simulation in an ED department	promote understanding of the logistical features of a pediatric ED

Zhang et al	2019	A Serious Logistical Game of Paediatric Emergency Medicine: Proposed Scoring Mechanism and Pilot Test	analog	simulation-based sandtable logistical board game	practice non-technical skills in the dynamic resource management of a pediatric ED
Douglas et al	2019	Gaming the system: building an online management game to spread and gather insights into the dynamics of performance management systems	digital	online management game	gain appreciation of performance management by applying metrics via different performance instruments
Bach et al	2018	Teaching health care management with simulation games	digital	simulation game	improve epidemic investigation and management knowledge
Lovreglio et al	2018	Prototyping virtual reality serious games for building earthquake preparedness: The Auckland City Hospital case study	digital	VR simulation training game	enhance participants' knowledge on how to behave during and after an earthquake
Ghazvini & Shukur	2018	A Serious Game for Healthcare Industry: Information Security Awareness Training Program for Hospital Universiti Kebangsaan Malaysia	digital	trivia computer game (InfoSecure)	raising employees' awareness towards information security
Barr-Walker & Nevels	2018	Creating value through outreach in a hospital setting: a case study from Zuckerberg San Francisco General Hospital Library	analog	spinnable wheel - quiz	increase staff and patients' awareness of hospitals' library resources and services
Thornton Bacon et al	2018	Enhancing Systems Thinking for Undergraduate Nursing Students Using Friday Night at the ER	analog	simulation-based board game (Friday Night at the ER)	promote quality and safety of healthcare systems
Vithanage et al	2017	Game of Hospitals	analog	role-playing games learning sessions (Game of Hospitals)	discussions of complex hospital clinical and administrative scenarios and their solutions
Jantana et al	2016	A multi-facet approach using conceptualization, application, and usability measurement for developing a financial learning system for hospitals	digital	business game simulation	enhance learning of financial management in healthcare
Gradel et al	2016	Simulating the physician as healthcare manager: An innovative course to train for the manager role	analog	gaming simulation seminar	increase basic knowledge of healthcare policy and management
Huyghe et al	2016	Involving End-Users in Game Based Ideation: A Case Study in Hospital Logistics	analog	tailored-made board game (based on Game of the Goose)	raise awareness on using wearable technology for logistical work in hospitals

Ruggiero	2016	Super Busy Hospital: wicked games that triage	analog	simulated gameplay sessions (Super Busy Hospital)	force players to apply ethical thinking in decision-making for triage situations
Cheong & Lim	2016	Scenario-based simulation game for hospital beds capacity planning in Singapore	digital	scenario-based simulation game	guide the learners through key considerations for bed capacity planning
Chalk & Manzi	2016	The Hospital Discharge Game : A game theory-inspired workshop to encourage cooperation between health and social care organisations	digital	interactive workshop game (Hospital Discharge Game)	promote whole systems thinking within the British National Health Service amongst practitioners and policymakers
Gaynor et al	2016	Teaching EHRs security with simulation for non-technical healthcare professionals	analog	simulation-based role-playing game workshop	teach complicated information technology (IT) concepts in non-technical managers
Shi et al	2015	3D Hospital: Design and Implement Quest-Based Game Framework for Transitional Training	digital	role-playing game with various quests	train participants on building work environment spatial contextual awareness
Guérin et al	2015	Change management in pharmacy: a simulation game and pharmacy leaders' rating of 35 barriers to change	analog	simulation game using a negotiation-based format	identify and rank barriers to change in a pharmacy department
Ribeiro et al	2013	Creating Awareness of Emergency Departments Healthcare Values Using a Serious Game	digital	3D simulation game (ImPROVE)	model the business process underlying the hospital ED and check its impacts on healthcare values
Basole et al	2013	Healthcare management through organizational simulation	digital	web-based simulation game (Health Advisor)	enhance healthcare management strategies aimed at addressing the trade-offs between good health outcomes and healthcare costs
Takemura et al	2013	The Development of a Multiplayer Game for Education of Hospital Management	digital	networked serious game	enhance education on hospital management and produce highly trained personnel
Broberg & Edwards	2012	User-driven innovation of an outpatient department	analog	tabletop simulation game	increase organization and functional layout of an outpatient department
Bregman et al	2009	An Internet-Based Simulation System for Training and Development of Regional-Healthcare-Centers Managers	digital	internet-based simulation game	support the training and development of regional healthcare managers
Rauner et al	2008	Competition under different reimbursement systems: The	digital	internet-based simulation management game	enhance economic and organizational decision-making to

		concept of an internet-based hospital management game		(COREmain hospital game)	improve hospital, regional, and national level policy-making
Uhles et al	2008	Simulation game provides financial management training	analog	workshop with a reality simulation game	teach the relationships between cash flow, income statements, and balance sheets
Levi & Bregman	2003	Simulation and management games for training command and control in emergencies	digital	computerized management simulation game	increase healthcare system disaster preparedness - improve management control

¹ Game short description and aim are described according to what authors have stated in their studies (in the majority of cases)

To answer the first research question, we located and removed studies reporting on the same digital tool in more than one publication. Accordingly, one study was excluded (Hiragi et al. 2020) and the most recent publication of the specific serious game was included (Hiragi et al. 2022). Furthermore, a study introducing two entirely distinct games was located (Pavillet & Dumas 2023). Therefore, we concluded that 36 serious games have been developed during the past vicennium to enhance hospital management knowledge and skills. Regarding serious game types, astonishingly 50% of them were digital and 50% were analog. However, three of the analog games also included some kind of multimedia presentation during the gameplay (Martin 2022; Barr-Walker & Nevels 2018; Vithanage et al. 2017). Figure 6.1 depicts the exact number of analog and digital games developed per triennial during the understudy period.

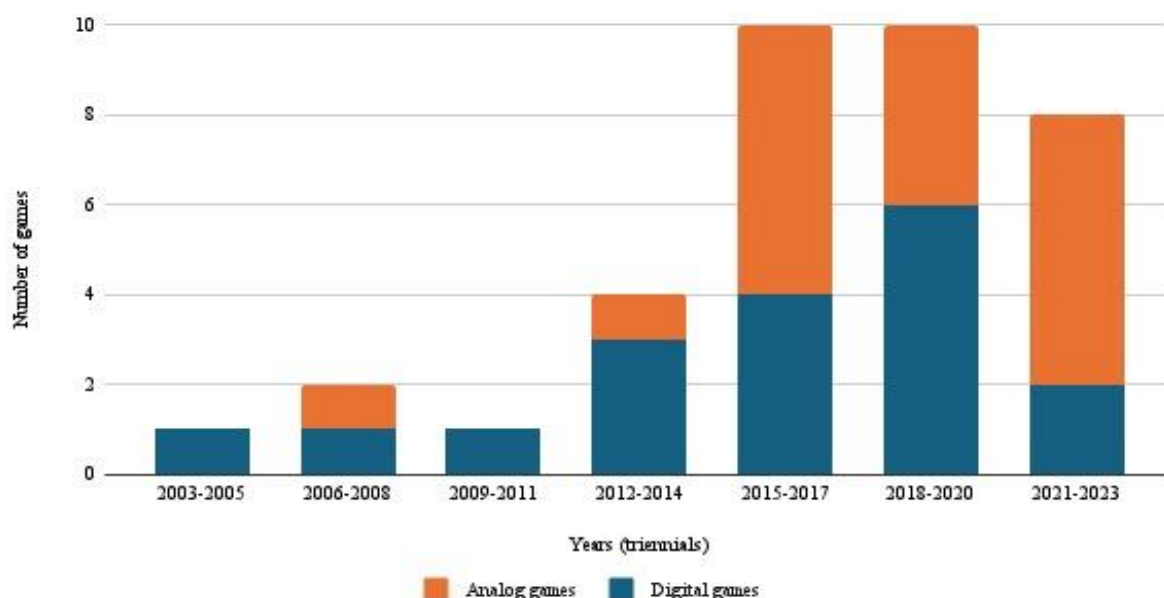


Figure 6.1. Number of identified digital and analog serious games per triennial (2003-2023)

Responding to the second research question, we categorized the studies according to their development sites. Consequently, 19 countries from four continents were identified. In Figure 6.2, the countries are depicted along with chromatic information regarding the number of published articles per country (the darker the color blue is, the greater the number of publications).

The pioneer country in utilizing serious games for hospital management educational purposes was the United States of America (USA) counting eight published articles within the study period. Also, the UK and Japan showcased a slightly increased number of publications ($n=3$), while all the other countries followed with one or two relevant articles published. However, we notice a lack of relevant publications from many world regions such as South America, Eastern Europe and the African continent. More analytical information on the exact number of studies each country yielded along with the references to those articles can be found in Appendix A.

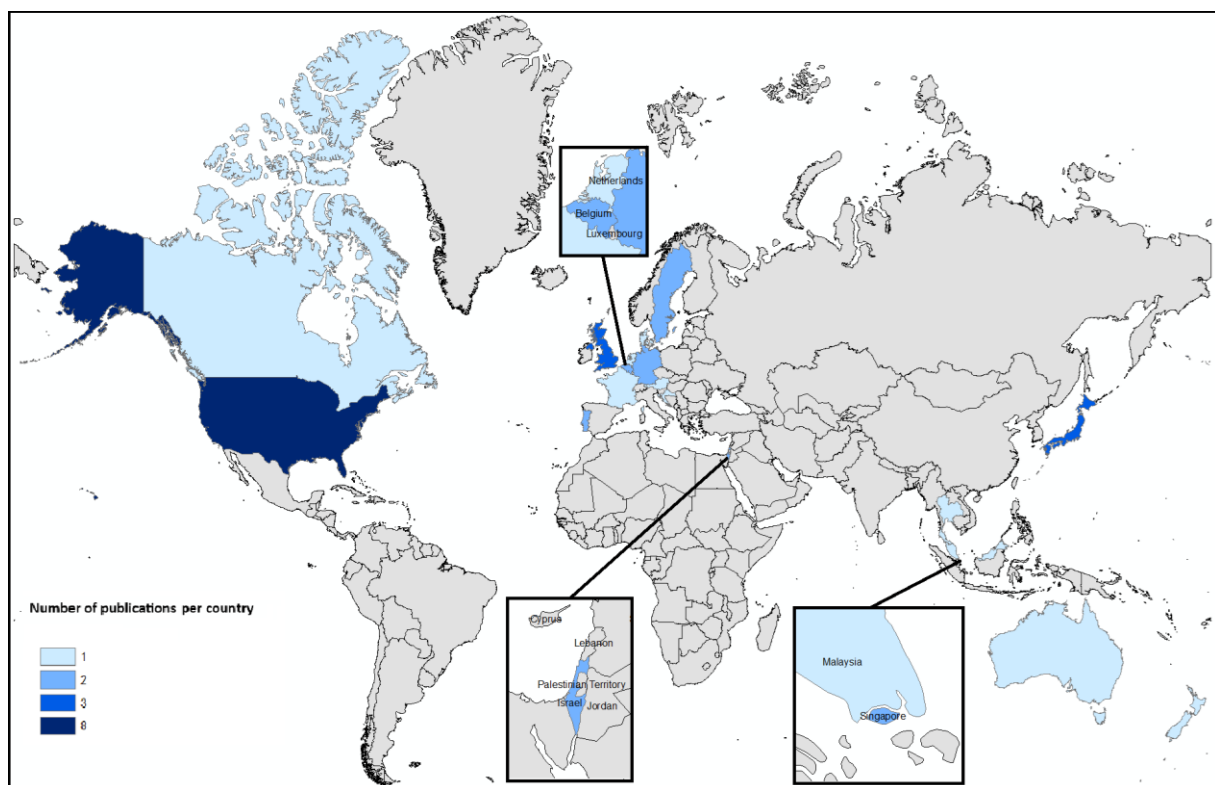


Figure 6.2. Number of studies published on hospital management serious games per country (2003-2023)

To answer the third research question, serious games were categorized into four broad groups according to the type of learning activity implemented. To this end, the categories were: 1) simulation games, 2) quizzes, 3) RPGs, and 4) board games and card games. Several serious games presented multiple learning activity features, however, the classification was made according to the games' predominant characteristic. For the serious game with the two publications, we included only the most recent article to avoid any overestimation. According to the results, the most common serious game type was by far simulation games (61.1%). Table 6.2 presents more information on the frequency and percentage per serious game learning category type along with the relevant studies' reference numbers. Furthermore, regarding game design features, it was estimated that 63.9% of the serious games were multiplayer games, (Pavillet & Dumas 2023; Martin 2022; Schwengel et al. 2022; Hiragi et al. 2022; Bacelar-Silva et al. 2021; Pulido et al. 2021; Tan et al. 2020; Zhang 2019; Thornton Bacon et al. 2018; Vithanage et al. 2017; Gradel et al. 2016; Huyghe et al. 2016; Ruggiero 2016; Chalk & Manzi 2016; Gaynor et al., 2016; Guérin et al. 2015; Broberg & Edwards 2012; Bregman et al. 2009; Rauner et al. 2008; Uhles et al. 2008; Levi & Bregman 2003) while 44.4% of them (Pavillet & Dumas 2023; Schwengel et al. 2022; Pulido et al. 2021; Zhang 2019; Thornton Bacon et al. 2018; Vithanage et al. 2017; Gradel et al. 2016; Huyghe et al. 2016; Ruggiero 2016; Chalk & Manzi 2016; Guérin et al. 2015; Broberg & Edwards 2012; Bregman et al. 2009; Rauner et al. 2008; Uhles et al. 2008; Levi & Bregman 2003) required also teamwork-based collaboration.

Table 6.2. Learning activity type implemented by the identified serious games

Learning activity type	Frequency (%) ¹ N=36 (100)	Studies references ² N=36
Simulation games	22 (61.1)	Hiragi et al. 2022; Rahouti et al. 2021; Hiragi et al. 2020; Zhang et al. 2020; Zhang 2019; Douglas et al. 2019; Bach et al. 2018; Lovreglio et al. 2018; Thornton Bacon et al. 2018; Jantana et al. 2016; Gradel et al. 2016; Ruggiero 2016; Cheong & Lim 2016; Chalk & Manzi 2016; Gaynor et al., 2016; Guérin et al. 2015; Ribeiro et al. 2013; Basole et al. 2013; Broberg & Edwards 2012; Bregman et al. 2009; Rauner et al. 2008; Uhles et al. 2008; Levi & Bregman 2003
Quizzes	4 (11.1)	Martin 2022; Höffner et al. 2022; Ghazvini & Shukur 2018; Barr-Walker & Nevels 2018
RPGs	3 (8.3)	Vithanage et al. 2017; Shi et al. 2015; Takemura et al. 2013
Board/card games	7 (19.5)	Pavillet & Dumas 2023; Schwengel et al. 2022; Bacelar-Silva et al. 2021; Pulido et al. 2021; Tan et al. 2020; Huyghe et al. 2016

¹ Multiple studies reporting on the same digital tool are excluded

² Studies reporting on the same digital tool are not excluded

Regarding the fourth research question, serious games were categorized into six broad thematic groups according to the teaching subject: 1) upper management games (n=19), 2) financial literacy games (n=4), 3) work organization games (n=3), 4) information security/cybersecurity games (n=4), 5) building information modeling games (n=4) and 6) other (n=2). Each teaching subject category percentage is represented in Figure 6.3. The upper management game category allows the participants to make decisions and enhance top management skills by filling roles in the higher organization hierarchy. In financial literacy games, players enhance financial knowledge and basic accounting skills by engaging in activities including cash flow, budgeting, and optimizing expenditures. Work organization games focus on improving the daily work environment such as enhancing team building and workflow organization. Information security games aim to provide knowledge about information management including electronic healthcare records and digital security. Building information modeling games encourages collaborative working in designing, exploring, and using buildings. Finally, serious games that didn't match any of the above categories were placed into the “others” group.

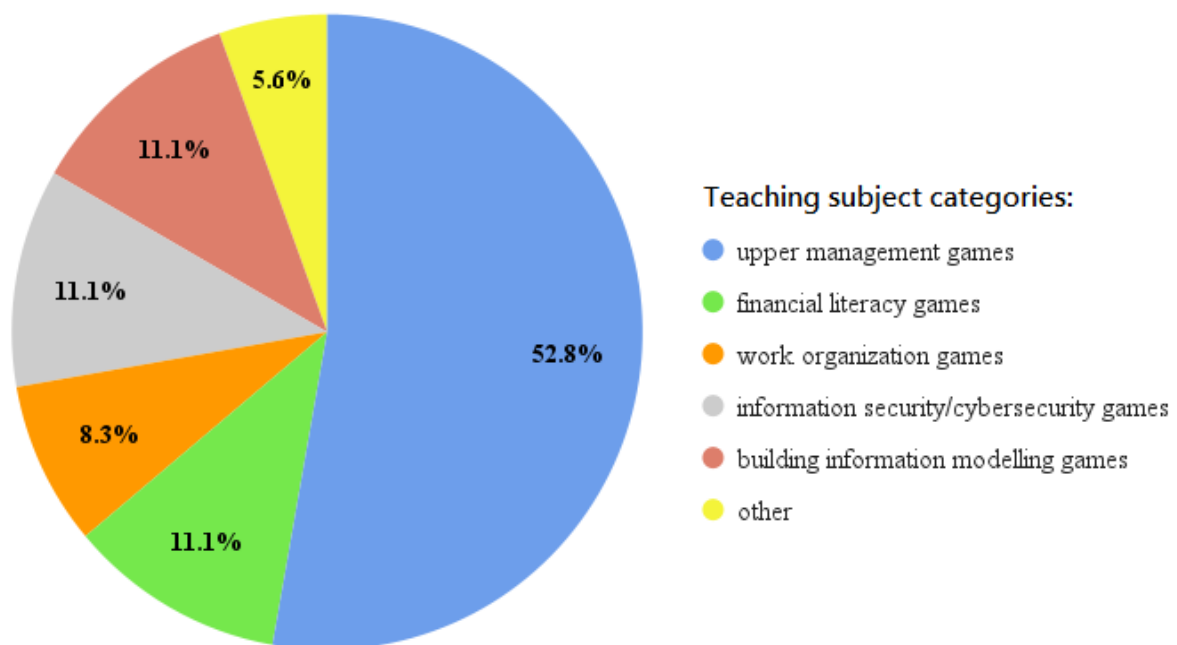


Figure 6.3. Percentage of serious games per teaching subject category

In regards of the skills that the identified serious games attempt to enhance, categories according to Katz’s three-skill approach for effective administration were created (Katz, 1955) including technical (38.9%, n=14), interpersonal (5.5%, n=2), and conceptual (55.6%, n=20) skills acquisition. Technical skills include: financial, digital literacy, designing work environments, and data analysis. Interpersonal skills revolve around effective communication, human behavior understanding, and motivating and empowering others. Conceptual skills are essential for top management since they focus on viewing the organization as a whole, evaluating situations, and making important strategic decisions (Gitman et al; 2019). The majority of serious games tried to enhance multiple skills. Therefore, we initially classified the games according to their main target in line with Katz’s three-skill approach but also provided a more analytical description of the different skills each game claimed to enforce which we depicted as subcategories of the technical, interpersonal, and conceptual skills in Figure 6.4. The above information is summarized in Table 6.3 (teaching subject, Katz’s three-skill categorization, analysis of skills each game tries to enforce, and game content description).

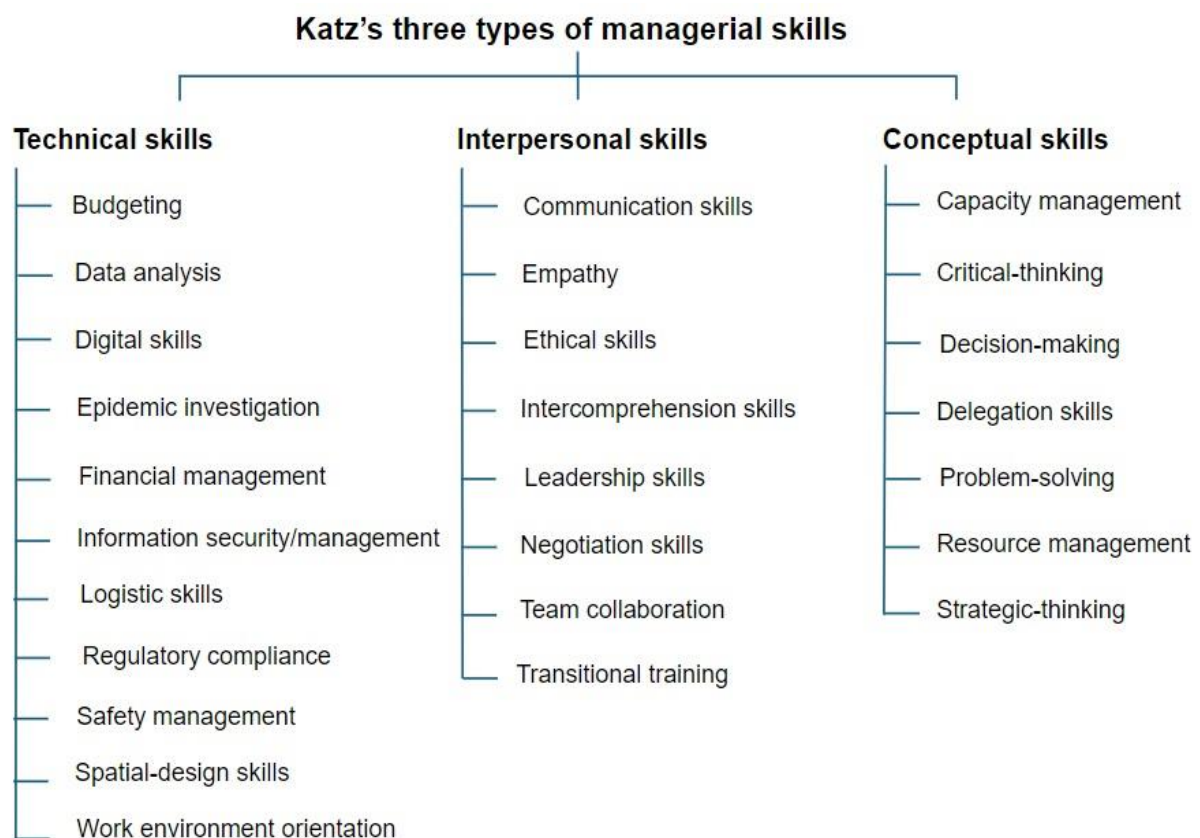


Figure 6.4. Classification of managerial skills the identified serious games try to enforce according to Katz’s three skills approach for leadership

As regards the enhancement of technical skills, the most commonly targeted were: financial management skills, information security management skills, regulatory compliance skills and safety management skills. For interpersonal skills, the most frequent competences mentioned among the included serious games were team collaboration skills and communication skills. Finally, as regards conceptual skills, decision-making skills, strategic thinking skills and resource management skills were more regularly targeted (Figure 6.5).

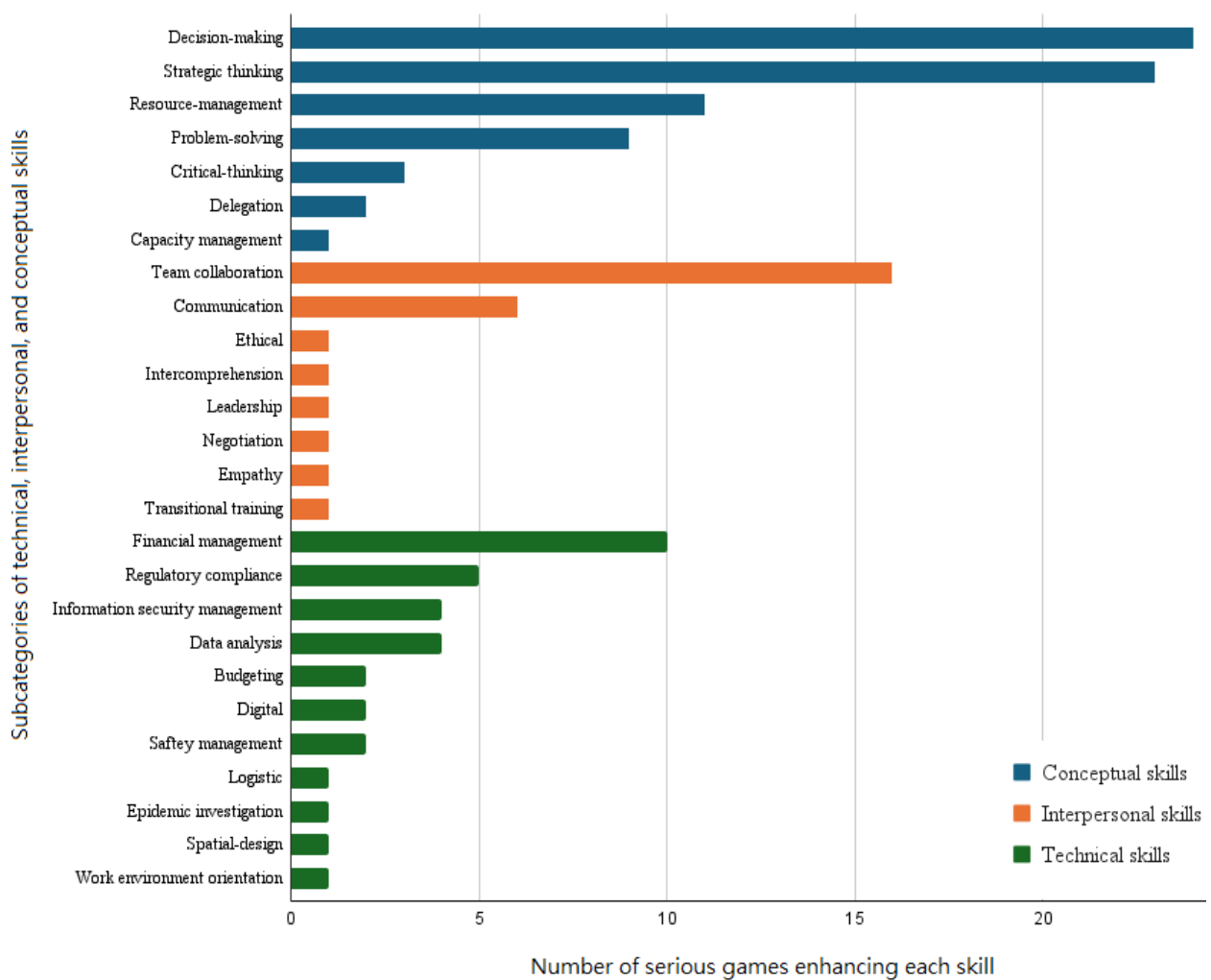


Figure 6.5. Number of serious games trying to enhance each skill subcategory according to three skills-approach by Katz

Table 6.3. Summary table of included studies educational subject, three-skill approach categorization, targeted skills enforcement, and game content description

Reference	Game's teaching subject	Three-skill approach categories	Skills game enforces	Game content description ¹
Pavillet & Dumas 2023	work organization	interpersonal	communication, team collaboration, empathy	"Dixit" cards encouraged staff expression - players chose a card from the deck and tell the others the reasons for their choice based on their professional experiences, encouraging listening and empathy
Pavillet & Dumas 2023	work organization	interpersonal	intercomprehension, team collaboration, communication	"Concept" makes people guess an object, a character, etc., using images on the game board. The discussion introduced professional situations that the team could encounter and that are sources of conflict
Martin 2022	financial literacy	technical	financial management, budgeting, delegation	"The Price Is Right" game shows students healthcare items that are briefly described, and their wholesale price is given. With class help, students guess the actual cost of each item that is charged to the patient
Höffner et al 2022	information security/ cybersecurity	technical	information security and management	"SNIK Quiz" is a multiple-choice quiz on health information management that trains basic facts, complex patterns, and connections of textbooks encoded in the Semantic Network of Information Management in Hospitals
Schwengel et al 2022	upper management	conceptual	strategic thinking, resource management, decision-making, problem-solving, delegation, team collaboration	In "Influx!" players must cooperatively manage a mass casualty incident. Four players are assigned roles and a facilitator monitors the game rounds where the influx of patients accelerates and resources become limited
Hiragi et al 2022	upper management	conceptual	strategic thinking, resource management (staff satisfaction), decision-making, leadership (equity)	Players are ward managers of 3 inpatient wards (1 each) setting a price for each illness and severity of their ward, without seeing patients admitted to other wards. A computer agent selects the cheapest ward for each patient unless the ward specialized in patient's illness is available
Bacelar-Silva et al 2021	upper management	conceptual	strategic thinking, resource management, decision-making, problem-solving	In "ED", players deliver care to emergency patients by making them flow till the discharge area. A round starts by rolling a die to define patient demand that can result in different treatment plans
Rahouti et al 2021	work organization	technical	safety management, regulatory compliance	In this VR participants are made aware of fire doors and evacuation routes of a hospital. Among learning objectives are: using alert

				buttons, calling the fire brigade, prioritizing and evacuating patients, etc.
Pulido et al 2021	information security/cybersecurity	technical	information security, critical thinking, problem-solving, team collaboration	This board game simulates security incidents that put health information at risk. The game is played by a group of 3-5 participants who collaborate as a team to reduce security threats through critical thinking and discussion
Tan et al 2020	financial literacy	technical	financial management, budgeting, decision-making, strategic thinking	Each player is a financial officer who oversees a fixed budget for flowing of a certain number of patients. To win, the player needs to achieve the best value for flowing each patient through different care settings by having the least average expenditure per patient within a specific timeframe
Zhang et al 2020	upper management	conceptual	resource management, strategic thinking, decision-making	The player is a management nurse who plans resource allocations at run time based on the ED to carry out a wide variety of activities
Zhang et al 2019	upper management	conceptual	decision-making, strategic thinking, resource management, team collaboration	The players represent inspectorates of the care production system and manage the triage station and five normal modules as parallel functioning production units of an ED. Players collaborate to develop a resilient pediatric ED from available human resources and stretchers
Douglas et al 2019	upper management	conceptual	strategic thinking, data analysis, decision-making	Players are hospital department managers balancing competing demands of doctors, patients, and financial officers. They use different management instruments and receive information on how these interventions affect outputs. If they fail to improve performance, they get fired
Bach et al 2018	other	conceptual	epidemic investigation, decision-making	Players control the size of the mosquito population, number of bites per mosquito/day, and the mosquito hatch fraction. Changes in these values reflect decisions that impact yellow fever spreading indicating different healthcare management actions before and after the disease spreads
Lovreglio et al	work organization	technical	safety management, regulatory compliance, decision-making	Players are guided through several scenarios in which they choose from recommended behaviors that align (or not) with the best practice. Players are exposed to a virtual environment that allows them to act according to the best evacuation practice or to take unsafe actions

Ghazvini & Shukur 2018	information security/cybersecurity	technical	information security, regulatory compliance, digital skills, decision-making	The serious game consists of eight topics each addressing one information security issue. The player is required to answer all questions correctly for each topic to obtain a full score, otherwise he/she must replay it
Barr-Walker & Nevels 2018	other	conceptual	strategic thinking, communication	The game utilized a spinnable wheel to ask players library-related questions. Each question was designed to promote library services, collections, and spaces entertainingly and engagingly
Thornton Bacon et al 2018	upper management	conceptual	strategic thinking, data analysis, problem-solving, team collaboration, decision-making, financial management	Players of "Friday Night at the ER" assume nurse leader roles to face real-life situations. Players practice handling high-stakes problems which are evaluated and scored on cost and quality outcomes based on the decisions made. Activities require collaboration and data analysis
Vithanage et al 2017	upper management	conceptual	problem-solving, strategic thinking, resource management, team collaboration	In "Game of Hospitals" 8 players (4 doctors and 4 hospital administrators) negotiate over complex hospital issues. Golden stars are awarded for each problem solved according to the positive impact of the provided solution
Jantana et al 2016	financial literacy	technical	financial management, decision-making	The player competes with a computer player as a rival user. Events feed both users and the system calculates decision cost strategy to determine the cost of financial outcome. Final results are based on the user's decisions
Gradel et al 2016	upper management	conceptual	strategic thinking, problem-solving, critical thinking, team collaboration, communication	Students are members of a Hospital's executive board and work on an existing hospital project as a group. Competition is created by forming two groups that work on the same project and present their work to each other in simulated board meetings turning the project into a gaming battle
Huyghe et al 2016	work organization	technical	logistic, critical thinking, problem-solving, team collaboration	This customized "Game of the Goose" includes action squares related to the hospital logistics. Players are introduced to question cards presenting problems that could be tackled using technology cards. Two teams played to allow competition but also cooperation within teams
Ruggiero 2016	upper management	conceptual	strategic thinking, resource management, decision-making, ethical skills, team collaboration, communication	In "Super Busy Hospital" players teams are given a list of the people in their triage area and the amount of time and resources for each. The task is to design an optimal system for addressing all the needs within the ED

Cheong & Lim 2016	upper management	conceptual	strategic thinking, capacity management, problem-solving, decision-making, financial management	Player is an officer at the Ministry of Health whose task is to study current and future planned capacity of public hospitals to decide if they satisfy the growing needs. If capacity is insufficient, the player decides which hospitals will add beds and when, and in which year a new hospital should be added
Chalk & Manzi 2016	upper management	conceptual	strategic thinking, decision-making, data analysis, team collaboration	Teams are given the roles of community and acute hospitals and are asked to make discharge decisions about patients. However, a 'perverse' incentive is present in the system, and opposing teams are not allowed to communicate, which leads to increasingly 'selfish' decision-making
Gaynor et al 2016	information security/cybersecurity	technical	digital skills, information security, regulatory compliance, decision-making	Players break into groups and the workshop gives each group encryption tool kits that copy props. Attendees take the roles of different people involved in electronically exchanging medical information. Simulation scenarios are played to demonstrate how to send health data that is protected
Shi et al 2015	work organization	technical	work environment orientation, transitional training	In "3D Hospital" the player explores the virtual hospital using a mini-map. The player has a clear objective in the form of a 'to-do list' including various quests that encourage the player to explore the work environment based on his/her daily tasks
Guérin et al 2015	upper management	conceptual	strategic thinking, decision-making, negotiation, communication	A group of 4-6 players forms a pharmacy department. They are given 41 multi-color construction blocks representing 4 domains: clinical, drug distribution, research, management. The game board has 28 block spots; they decide how many blocks of each domain form the "ideal" department
Ribeiro et al 2013	upper management	conceptual	strategic thinking, decision-making, financial management, resource management	In "ImPROVE" the player is a department manager aiming to restructure the ED by adapting business processes inherent to the department's functioning. The player manages different business processes utilizing an authoring business process tool using activities, decision points, etc.
Basole et al 2013	upper management	conceptual	strategic thinking, data analysis, decision-making, financial management	In "Health Advisor" players have the objective of managing a set of clients through the healthcare system by making various information, cost, and quality of care trade-off decisions
Takemura et al 2013	upper management	conceptual	strategic thinking, resource management, decision-making	Player is the director of a hospital and makes management decisions under various constraints

				indicators that affect his/her own hospital, as well as, other hospitals
Broberg & Edwards 2012	work organization	conceptual	strategic thinking, spatial design, team collaboration	Players designed their dream department game board using cardboard pieces representing staff members, rooms, and activities. Then they designed it in a rectangular layout. A LEGO figure was used as a patient, to showcase patient flow. Many scenarios with LEGO figures were also played
Bregman et al 2009	upper management	conceptual	decision-making, strategic thinking, resource management, financial management, team collaboration	In this game, teams are Regional Healthcare Centers managers, within one specific community, and compete with each other. The simulation focuses on managerial performance, based on periodic team decisions, within the internal and external environmental context
Rauner et al 2008	upper management	conceptual	decision-making, strategic thinking, resource management, financial management, team collaboration	“COREmain Hospital” is a game for up to six hospitals that compete with each other. Each hospital has 4 players and each player is responsible for 1 department (management, nursing, radiology, surgery). The game trains decision-making within a team as decisions of one department affect others
Uhles et al 2008	financial literacy	conceptual	strategic thinking, problem-solving, financial management, decision-making, team collaboration	The six members of each team represent executives of a healthcare facility, working together toward financial goals. They make decisions as events take place and information becomes available, and observe the results of their actions
Levi & Bregman 2003	upper management	conceptual	strategic thinking, decision-making, regulation compliance, team collaboration	This game first gives information by graphic interface of the event and scene and secondly, assesses the data gathered by the teams and the way they support managerial decisions.

¹ Gameplay description according to what authors have reported in their studies

Furthermore it was observed that the vast amount of the studies (69.5%, n=25), included photos of the developed serious games in their articles (or via links provided within the articles). Furthermore, via internet search we were able to locate the images from another 3 games (8.3%). This was very helpful in visualizing the information provided in the manuscripts and understanding better the gameplay of each serious game. Only 22.2% of the articles (n=8), did not provide relevant photographic material (4 analog and 4 digital games). Photos of the

emerged serious games can be found in Appendix B classified in 2 Tables (Table 1. Digital serious games and Table 2. Analog serious games).

The current results confirm the first part of the research hypothesis according to which an increase in the overall number of hospital management serious games was expected. However, the second part of the research hypothesis that was predicting a higher percentage of digital serious games was not supported by the results. A more thorough analysis of the above observations is provided in the discussion section (Chapter 7).

CHAPTER 7

DISCUSSION

This is the first contemporary systematic review reporting on the development and implementation of digital and analog serious games in hospitals' management field. A similar-themed extensive review was conducted 15 years ago revealing 13 hospital management games published during 1978-2008 (Kraus et al. 2010). More recent relevant reviews include a systematic review on gamification in healthcare management, that however excluded articles referring to serious games, focusing solely on the application of game elements in non-playful environments (gamification) (Gajardo Sánchez et al. 2023). Furthermore, a systemized literature review assessed operational research and management science (ORMS) games that could be utilized in healthcare. Nonetheless, the review did not reveal any serious games on ORMS for healthcare but identified six games that could be adapted to serve healthcare purposes (van Zyl-Cillié 2023).

The current findings suggest that serious game application in the healthcare management field has not increased tremendously over the past years; rather a steady increase is observed in the triennals from 2015 and onwards. What is of note, is that analog serious games are more common in the past 10 years compared to digital ones. This observation opposes the literature which supports that COVID-19 pandemic accelerated digital educational tools transformation, with a plethora of serious digital games being developed in various health-related disciplines (Chatzea et. al 2024; Kermavnar et al. 2023; Sipiyaruk et al 2021). This finding is partially explained according to one of the included studies, which supports that board games increase social relatedness and enrich players' experience while participants (older working adults) are more familiar with board game format and assimilate the rules quicker compared to digital games (Tan et al. 2020). Furthermore, the majority of the identified serious games were multiplayer games requiring team collaboration; along this line literature supports that board games provide better opportunities for between-player discussion and allow more room for players to engage in deeper thinking, enhancing further knowledge acquisition compared to digital games (Kaufman et al. 2016).

Concerning the geographical distribution of identified serious games, results indicate a moderate distribution mainly in European, North American, and Asian countries. This is

consistent with a recent bibliometric analysis, which also places North America and Europe as the continents with the highest number of serious game-associated publications (Irmade et al. 2021). Furthermore, according to our findings, the USA is the pioneer in the field, counting 8 distinct serious games on hospital management. Indeed, literature agrees that the USA is the largest contributor to serious game development according to several studies focusing either on the healthcare sector or other disciplines (Dicheva et al. 2023; Wang et al. 2022; Irmade et al. 2021).

Regarding the most common learning activity type, simulation serious games have the lion's share. Especially virtual simulation usage has increased worldwide in the past years, since it is proven to improve learners' experience at all educational levels, subjects, and contexts (Lampropoulos & Kinshuk 2024). Simulation games utilize reality-based scenarios with action-oriented activities (Geithner & Menzel 2016) resulting in powerful educational tools for promoting teamwork and collaboration (Lin 2016; Hannig et al. 2013), but also aid mastering managerial and leadership skills such as complex and dynamic decision-making (Vlachopoulos, & Makri 2017; Wang C et al. 2016). To this end, a systematic review of different serious game genres, identified simulations as the most prominent serious game genre for higher education (Vlachopoulos, & Makri 2017).

As regards the most common subject among the identified serious games, upper management skills-themed games were the most predominant. This was expected since this category incorporates a wide range of important managerial and administrative duties including strategic planning, decision-making, and resource management which are key skills for every hospital executive. However, important game subjects such as financial literacy and information security games also emerged. Several members with higher administrative roles in hospitals are doctors/nurses which creates a difficulty to understand complicated financial processes; thus, providing financial lessons in the form of serious games is rather helpful (Jantana et al. 2016). Additionally, data security is a complex concept for many healthcare managers therefore basic training on understanding data encryption and healthcare record privacy is considered crucial (Gaynor et al. 2016).

Finally, Katz's three-skill approach theory (Katz, 1955) was embarked to classify the basic skills categories that the identified serious games tried to enhance. In a legendary article published in 1955, Katz introduced the necessary "management skills" based on three categories: technical, interpersonal, and conceptual skills (Gutterman 2023). Interpersonal

skills are important at every management level, technical skills are most important at lower and middle management levels and conceptual skills are most important at the top management level (Northhouse 2018). We chose to utilize the specific theoretical model since it is widely accepted by the scientific community and could perfectly incorporate all the individual subcategory skills within its main three-skill classification.

Summarizing, the literature supports that today's management education needs to go beyond traditional teaching models (Sierra Pierna 2020). This document offers a coherent literature review on multiple serious games being developed regarding different educational subjects, targeting diverse populations and enhancing several managerial skills. This systematic review could serve as an inspiration and guidance for academics and healthcare stakeholders for including innovative serious games as part of hospital management training programs either at the postgraduate level or for life-long training.

7.1 Limitations

A potential limitation lies within selection bias; “serious game” is a relevantly old term (1970) that became popular over the past 15 years. Indeed, only 13 of the included articles utilized the term “serious game” in the text. Therefore, robust search algorithms were created including a wide range of relevant keywords to minimize the risk of not identifying relevant studies. Furthermore, another limitation lies within the classification for certain categories (learning activity types and game’s teaching subject). These categories have a scientific basis, however, due to the heterogeneity of the reported information, we improvised to a certain extent to be able to report the data in more homogeneous categories.

Also, we acknowledge that among the included studies, is a serious game not aiming directly to enhance participants’ managerial knowledge and skills, rather than creating value, promoting awareness and enhancing accessibility of a hospital’s department (Barr-Walker, and Nevels 2018). We chose to incorporate it in our results, since it indeed developed a serious game by thinking strategically and advancing the efficiency and efficacy of the department (library). Indeed attendees increased by over 240% and meaningful interactions increased by 1,300% from the previous year, so it was a useful and with high organizational impact serious game.

CHAPTER 8

CONCLUSIONS

Serious games is an emerging field identified as a potential pedagogical strategy to transform education by increasing knowledge, skills, and satisfaction compared to traditional learning. Undoubtedly, serious games have conquered many scientific fields, and although in hospital management education the advances are rather modest, there are plenty of opportunities and benefits that learners could reap.

Given the significant learning impact of serious games, this master thesis covers an existing research gap in the literature by following a coherent and comprehensive research methodology to inform a systematic review on serious game initiatives that could be utilized to enhance hospital management education. To this line, several important findings were derived including the number of serious games developed and implemented in the hospital management field the past 20 years (36 serious games), their level of digitalization (50%), their geographical distribution (19 countries), the most common serious games types (simulations and board/card games) and their prevalent gameplay characteristics (multiplayer and collaborative gaming). Furthermore, the most frequent educational subjects (upper management, financial literacy and information security themed games) along with the management skills they most often try to enhance (decision-making, strategic thinking and team collaboration) were highlighted.

Hence, this dissertation can be perceived as a useful guideline for those who desire to lead the way in a more synchronous, fun, and engaging learning experience as it offers a palette of distinguished choices that could be exploited by academics, hospital managers, and healthcare policymakers to enhance hospital management knowledge and healthcare administrative skills acquisition to create more successful and high-performing hospital executives. Future research should open a discussion regarding the approval of health-related serious games by an official authority body. The need is more imperative regarding the design and implementation of disease-management serious games addressing patients (Chen et al. 2023). However, the entire healthcare community could greatly benefit from the establishment of such an authority with the important task of certifying healthcare-related serious game applications.

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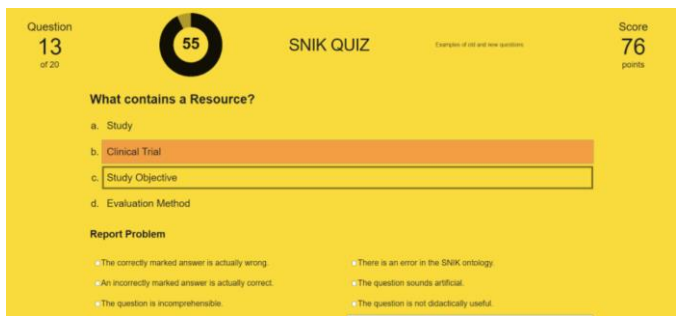
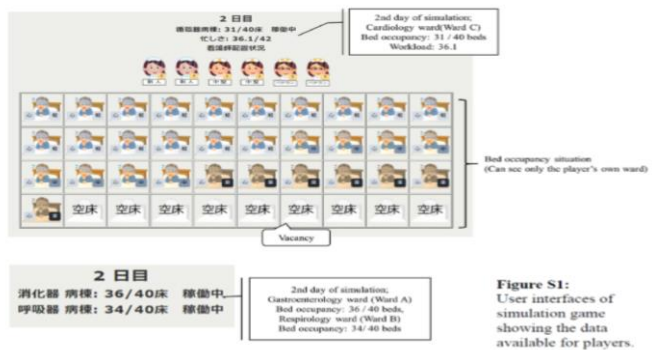
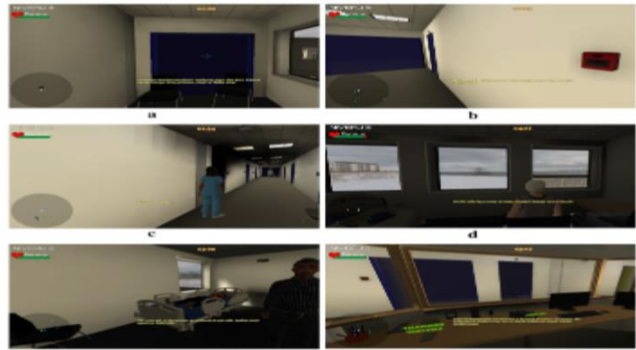
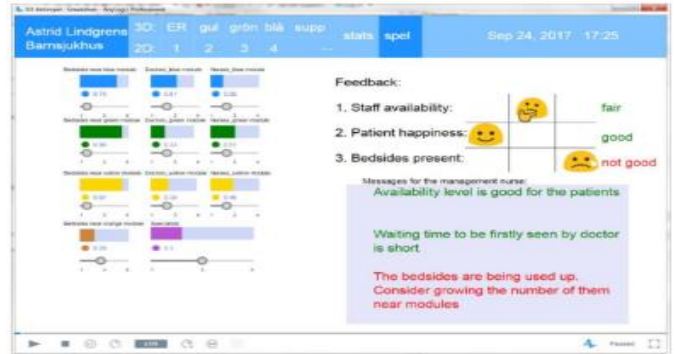
APPENDIX A

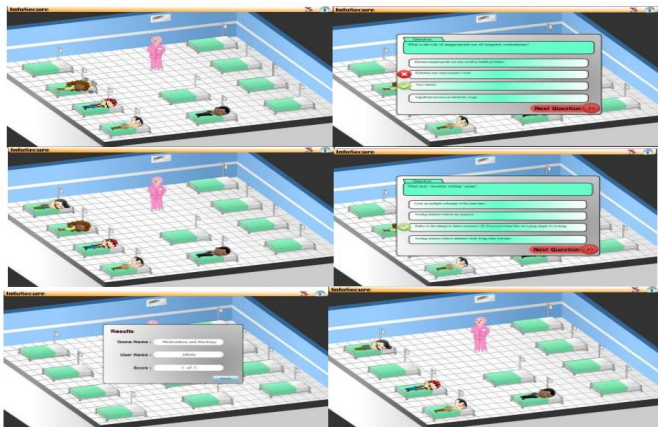
Table 1. Identified studies per country

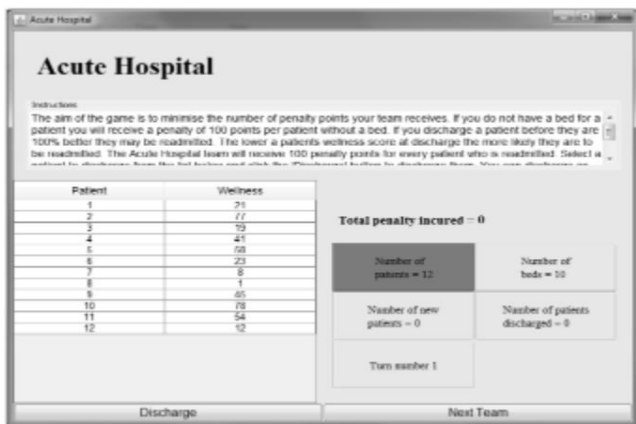
Country	Number of studies	Studies reference
Australia	1	Vithanage et al. 2017
Austria	1	Rauner et al. 2008
Belgium	2	Rahouti 2021; Huyghe et al. 2016
Canada	1	Guérin et al. 2015
Croatia	1	Bach et al. 2018
Denmark	1	Broberg et al. 2012
France	1	Pavillet & Dumas 2023
Germany	2	Höffner et al. 2022; Gradel et al. 2016
Israel	2	Bregman et al. 2009; Levi & Bregman 2003
Japan	3	Hiragi et al. 2022; Hiragi et al. 2020; Takemura et al 2013
Malaysia	1	Ghazvini & Shukur 2018
Netherlands	1	Douglas et al. 2019
New Zealand	1	Lovreglio et al. 2018
Portugal	2	Bacelar-Silva et al. 2021; Ribeiro et al. 2013
Singapore	2	Tan et al. 2020; Cheong & Lim 2016
Sweden	2	Zhang et al. 2020; Zhang et al. 2019
Thailand	1	Jantana et al. 2016
UK	3	Pulido et al. 2021; Ruggiero 2016; Chalk & Manzi 2016
USA	8	Martin 2022; Schwengel et al. 2022; Barr-Walker & Nevels 2018; Thornton Bacon et al. 2018; Gaynor et al. 2016; Shi et al. 2015; Basole et al 2013; Uhles et al. 2008

APPENDIX B

Table 1. Photos of the included digital serious games

a/a	Photo	Study short title and reference
1		The SNIK QUIZ Höffner et al. 2022
2	 Figure S1: User interfaces of simulation game showing the data available for players.	Token Economy-Based Hospital Bed Allocation Game Hiragi et al. 2022
3		Virtual Reality Serious Game for Healthcare Fire Safety Training Rahouti et al. 2021
4		Serious Gaming of Logistics Management in Pediatric Emergency Medicine Zhang et al. 2020

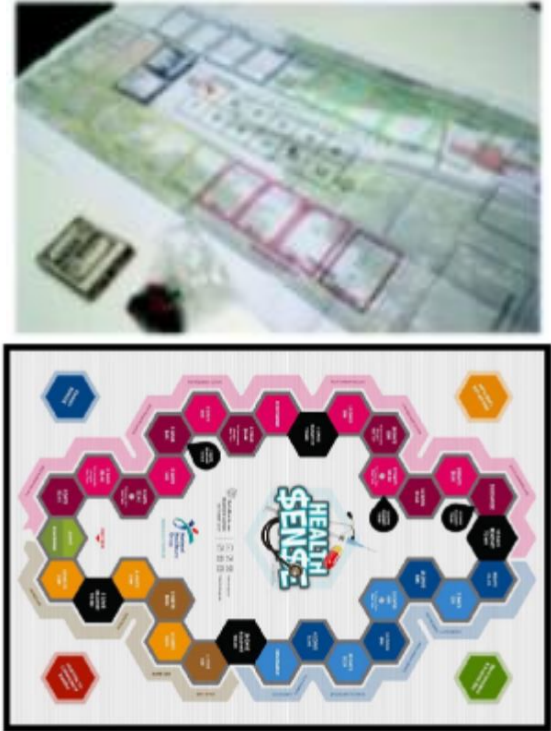
5		Online Management Game Douglas et al. 2019																																				
6		VR Serious Games for Building Earthquake Preparedness Lovreglio et al. 2018																																				
7		The InfoSecure Game Ghazvini, & Shukur 2018																																				
8	 <table><thead><tr><th>Hospital</th><th>Total # bed</th><th>Beds Supply</th><th># of people using hospital</th><th>Beds Demand</th><th>Utilization</th></tr></thead><tbody><tr><td>Total</td><td>7542</td><td>6788</td><td>355056</td><td>6779</td><td>100%</td></tr><tr><td>Alexandra Hospital</td><td>491</td><td>380</td><td>21992</td><td>368</td><td>100%</td></tr><tr><td>Singapore General Hospital</td><td>1700</td><td>1536</td><td>101290</td><td>1225</td><td>112%</td></tr><tr><td>National University Hospital</td><td>1002</td><td>929</td><td>34179</td><td>581</td><td>63%</td></tr><tr><td>K2J Whewell's and Chubbeck Memorial</td><td>9381</td><td>787</td><td>40288</td><td>209</td><td>100%</td></tr></tbody></table>	Hospital	Total # bed	Beds Supply	# of people using hospital	Beds Demand	Utilization	Total	7542	6788	355056	6779	100%	Alexandra Hospital	491	380	21992	368	100%	Singapore General Hospital	1700	1536	101290	1225	112%	National University Hospital	1002	929	34179	581	63%	K2J Whewell's and Chubbeck Memorial	9381	787	40288	209	100%	Simulation Game for Hospital Beds Capacity Planning Cheong, & Lim 2016
Hospital	Total # bed	Beds Supply	# of people using hospital	Beds Demand	Utilization																																	
Total	7542	6788	355056	6779	100%																																	
Alexandra Hospital	491	380	21992	368	100%																																	
Singapore General Hospital	1700	1536	101290	1225	112%																																	
National University Hospital	1002	929	34179	581	63%																																	
K2J Whewell's and Chubbeck Memorial	9381	787	40288	209	100%																																	

9	 Acute Hospital Instructions The aim of the game is to minimise the number of penalty points your team receives. If you do not have a bed for a patient you will receive a penalty of 100 points per patient without a bed. If you discharge a patient before they are 100% better they may be readmitted. The lower a patient's wellness score at discharge the more likely they are to be readmitted. The Acute Hospital team will receive 100 penalty points for every patient who is readmitted. Select a patient for admission. Remove them from the queue and check their (Phonetic) health for admission. Remove them once admission is complete. <table><thead><tr><th>Patient</th><th>Wellness</th></tr></thead><tbody><tr><td>1</td><td>21</td></tr><tr><td>2</td><td>77</td></tr><tr><td>3</td><td>79</td></tr><tr><td>4</td><td>41</td></tr><tr><td>5</td><td>58</td></tr><tr><td>6</td><td>23</td></tr><tr><td>7</td><td>8</td></tr><tr><td>8</td><td>1</td></tr><tr><td>9</td><td>65</td></tr><tr><td>10</td><td>78</td></tr><tr><td>11</td><td>54</td></tr><tr><td>12</td><td>92</td></tr></tbody></table> Total penalty incurred = 0 Number of patients = 12 Number of beds = 10 Number of new patients = 0 Number of patients discharged = 0 Turn number 1 Discharge Next Team	Patient	Wellness	1	21	2	77	3	79	4	41	5	58	6	23	7	8	8	1	9	65	10	78	11	54	12	92	The Hospital Discharge Game Chalk & Manzi 2016
Patient	Wellness																											
1	21																											
2	77																											
3	79																											
4	41																											
5	58																											
6	23																											
7	8																											
8	1																											
9	65																											
10	78																											
11	54																											
12	92																											
10		3D Hospital Shi et al. 2015																										
11		ImPROVE Serious Game Ribeiro et al. 2013																										
12		Health Advisor Simulation Game Basole et al. 2013																										

13		Multiplayer Game for Education of Hospital Management Takemura et al. 2013
14		COREmain Hospital Game Rauner et al. 2008

Table 2. Photos of the included analog serious games

a/a	Photo	Study short title and reference
1		Dixit Card Game Pavillet & Dumas 2023
2		Concept Board Game Pavillet & Dumas 2023 Image attribution: JIP - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=39470610
3		Influx! Board Game Schwengel et al. 2022 Image attribution: https://theinfluxgame.com/
4		Emergency Department Board Game Bacelar-Silva et al. 2021

5		Lego-Based Designed Board Game Pulido et al. 2021
6		Health\$en\$e™ board game Tan et al. 2020
7		A Serious Logistical Game of Paediatric Emergency Medicine Zhang et al. 2019

8		Wheel of Fortune Quiz Barr-Walker & Nevels 2018
9		Friday Night at the ER Thornton Bacon et al. 2018 Image attribution: Bettégardner at English Wikipedia, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=73226965
10	Round #6 Your hospital has been allocated a new budget for infection control. How will you invest these funds? (what are the emerging risks?)  Round #3 What will your hospital do? 1. Extend the alcohol hand wash campaign, including improved distribution of the hand wash and promotion posters 2. Hire 2 extra microbiologists to extend the current surveillance program 3. Design and implement new uniforms for all staff to be supplied and cleaned by the hospital 4. Increase the existing hospital in the home budget for outpatients and rehab patients. 	Game of Hospitals Vithanage et al. 2017
11		Hospital Logistics Board Game Huyghe et al. 2016

12		Super Busy Hospital Ruggiero 2016
13		Tabletop Simulation Game on Designing an Outpatient Department Broberg & Edwards 2012
14		Simulation Game on Financial Management Training Uhles et al. 2008