

Review

Digital Serious Games for Undergraduate Nursing Education: A Review of Serious Games Key Design Characteristics and Gamification Elements

Vasiliki Eirini Chatzea ^{1,*} , Ilias Logothetis ¹ , Michail Kalogiannakis ² , Michael Rovithis ³ 
and Nikolas Vidakis ¹ 

¹ Department of Electrical & Computer Engineering, Hellenic Mediterranean University, Estavromenos, 71410 Heraklion, Greece; iliaslog@hmu.gr (I.L.); nv@hmu.gr (N.V.)

² Department of Special Education, University of Thessaly, 38221 Volos, Greece; mkalogian@uth.gr

³ Department of Business Administration and Tourism, Hellenic Mediterranean University, Estavromenos, 71410 Heraklion, Greece; rovithis@hmu.gr

* Correspondence: vchatzea@hmu.gr

Abstract

Serious games in nursing education provide students with unique opportunities to increase knowledge and enhance decision-making and problem-solving skills. Hence, serious games from simple quizzes that test students' knowledge to Virtual Reality simulations that gauge students' ability skills have been developed. This evidence-based review examines the latest initiatives in serious games for nursing curriculum focusing on the design and their technological features to highlight the need of pre-selecting the appropriate elements when conceptualizing a nursing serious game. Using search algorithms in Scopus and PubMed, 1969 articles published between 2019 and 2023 were screened, resulting in 81 studies and 69 unique nursing serious games involving over 7000 nursing students. Geographical distribution of serious games, the games' type, teaching subject, nursing courses incorporating the games, technologies embarked, and different gaming platforms/engines utilized for their development are reported. Furthermore, common gamification elements (e.g., score, avatars, and quests) and key-design features (e.g., player mode, player–game interaction, feedback provision, and failure option) are described. By reporting on the latest technological advancements, a useful guide is formed, enabling both programmers and educators to easily grasp the newest trends on serious game design and use the produced knowledge to further enhance the nursing curriculum.

Keywords: nursing education; nursing students; serious games; game-based learning; educational games; gamification; virtual reality; review



Academic Editor: Yu-Cheng Wang

Received: 28 August 2025

Revised: 26 September 2025

Accepted: 7 October 2025

Published: 9 October 2025

Citation: Chatzea, V.E.; Logothetis, I.; Kalogiannakis, M.; Rovithis, M.; Vidakis, N. Digital Serious Games for Undergraduate Nursing Education: A Review of Serious Games Key Design Characteristics and Gamification Elements. *Information* **2025**, *16*, 877. <https://doi.org/10.3390/info16100877>

Copyright: © 2025 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Game-based learning, particularly through the use of serious games, can enhance learner motivation and cognitive results, making it a powerful motivation driver [1]. Serious games are designed for educational or informational purposes, merging serious learning elements with enjoyable and playful aspects of gaming [2]. According to the above definition and for the purposes of this study, serious games are defined as educational digital applications designed to consistently combine meaningful purposes—such as teaching, learning, communication, or information—with engaging and fun game elements. Unlike other games, they integrate educational or practical objectives through structured content

and rules. Research indicates that serious games are effective pedagogical tools compared to conventional teaching methods [3] and have been widely used to enhance the learning experience, improve knowledge retention, and increase student engagement [4].

During the past decade, serious games brought significant changes in healthcare education [5], with nursing education being no exception [6–8]. From simple quizzes that test students' knowledge to virtual simulation applications that gauge students' skills, serious games have been widely implemented as educational tools, with the latest initiatives incorporating Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR) [9]. Their effectiveness is supported by two recent meta-analyses reporting their positive impact on knowledge, skills, and the self-confidence of nursing students [7,10]. Furthermore, the literature indicates that serious games in nursing education enhance clinical skills training in risk-free environments and increase competencies related to interpersonal skills, boosting meaningful learning motivation [11].

This review compiles all articles published during 2019–2023 introducing digital serious games developed for undergraduate nursing education. Additionally, it highlights technical and technological aspects of the enclosed games and offers valuable insights into the game design elements and features to facilitate interested stakeholders in developing new, effective, and fun serious games for the nursing curriculum. The synthesis of the knowledge is important because the findings offer a palette of distinguished choices and alternatives that could be further exploited to help educators and developers focus on what works best for each serious game according to the game subject, the implemented learning activities, the available technological resources, and several other important parameters.

2. Materials and Methods

The review was conducted in PubMed and Scopus databases from 2019 to 2023. The research questions that guided this study were:

- Question 1 (Q1):
 - Q1.1 How many articles on serious games for undergraduate nursing education have been published during the understudy period?
 - Q1.2 Are these publications distributed evenly across different regions of the world?
- Question 2 (Q2):
 - Q2.1 How many distinctive serious games have been developed and implemented for undergraduate nursing students within 2019–2023?
 - Q2.2 Which learning-type activities do they most commonly incorporate?
 - Q2.3 What are the most prevalent teaching subjects covered by nursing serious games?
 - Q2.4 Which nursing curriculum courses most often incorporate serious games?
- Question 3 (Q3):
 - Q3.1 Which technologies are most frequently encountered in nursing serious games?
 - Q3.2 What key design characteristics can be identified across the enrolled studies?
- Question 4 (Q4):
 - Q4.1 Which elements of gamification are employed in nursing serious games?

To address the research questions, a peer-reviewed search strategy was followed. The first step was to develop search algorithms incorporating the most relevant keywords in two main categories: (1) nursing education-related keywords and (2) serious games scientific terms. Following that, the search strategy was refined by an expert following established best practices to ensure methodological rigor and comprehensiveness. Two search algorithms were implemented: one in Scopus, a more technical research database, and another in PubMed, a more health-related topic database. The PubMed search algorithm

also included relevant mesh terms, while the Scopus algorithm utilized several keywords to ensure a thorough literature review (Appendix A, Table A1).

Among the inclusion criteria were studies published between 2019 and 2023; studies in English; studies involving only/primarily undergraduate nursing students; and studies focusing on digital serious games for undergraduate nursing education. Among the exclusion criteria were studies implemented in healthcare students of other disciplines; studies involving nurses and/or other healthcare professionals; studies including nursing students but implementing serious games not designed for undergraduate nursing education; studies on the design of serious games that have not yet been implemented in classrooms; and studies that could not be accessed in full-text form.

The first step of the review process was to remove duplicate articles. Then, article titles were assessed for relevance. Following that, abstracts were carefully read to identify studies of interest. Finally, a detailed examination of the articles' full text was conducted to determine which studies should be included. Figure 1 presents the study selection flowchart following PRISMA 2020 guidelines [12]. In total, the search algorithms yielded 1969 articles. After a comprehensive review, 81 studies were included in the sample. Appendix A (Table A2) provides a detailed summary of the review process. It is important to mention that 116 duplicate studies were found (listed in “excluded from title” column). Furthermore, 16 studies unavailable in full-text (listed in “excluded from full-text” column) were removed. Furthermore, a trend analysis is presented in Figure A1 in Appendix, illustrating publication growth overtime.

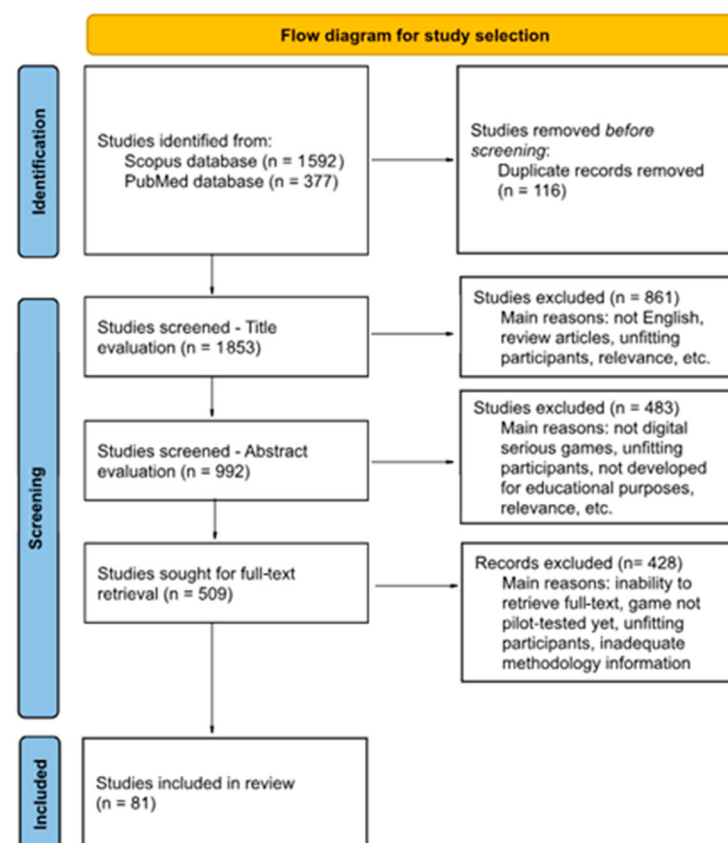


Figure 1. Study selection flow diagram.

An Excel spreadsheet was utilized to extract variables of interest. One author carried out the data extraction process, which was then verified by two other authors based on their expertise (one focused on nursing education-related variables and another confirmed data on serious games technologies, characteristics, and features). Any disagreements

were initially addressed through discussion and consensus between the primary reviewers. If consensus could not be reached, conflicts were resolved by an external independent reviewer. Extracted information included country of implementation, publication year, sample size, academic year of nursing students, educational subject, enrolled nursing courses, as well as various data regarding game design features, the technologies and devices embarked, player–game interactions, key-gamification elements, type of learning activities, and other technical/technological characteristics.

3. Results

The review included 81 articles [13–93]. Descriptive information on the studies is provided in Table 1. Most articles were published in 2022 ($n = 27$) and 2023 ($n = 25$), while fewer were published in 2020 and 2019 (Appendix A Table A2). The overall study sample was 7215 undergraduate nursing students from 74 studies reporting the exact number of students in their sample (nursing students solely or combined with faculty, graduate students, or other healthcare students). To estimate the sample size, we excluded studies that (1) did not report participants' sample [51,55,75], (2) utilized the same study sample as a previous publication [47,71], and (3) enrolled nursing and paramedical students without specifying each group size [68].

Table 1. Summary table of the included studies and overview of emerging serious games.

Author	Short Game Description ¹	Basic Design Info ¹
Adhikari et al. [13]	Game reflected key areas of clinical assessment and decision-making to improve self-efficacy in managing a case of pneumonia with sepsis.	IVR simulation
Akbari et al. [14]	“PlaSurIn” is a game of surgical instruments setup for the nursing field containing a virtual, learning, and an assessment mode.	Virtual training serious game
Al-Mugheed et al. [15]	Standard precautions compliance game for hand hygiene, personal protective equipment, sharps safety, and transmission-based precautions.	Game-based VR mobile application
Anton-Solanas et al. [16]	To exit the escape room, students had to solve 6 puzzles/scenarios using resources and activities available to them through Moodle.	Digital escape room
Arias-Calderón et al. [17]	5 serious game teaching activities, such as drag-and-drop classification, conceptual maps, paired items, and multiple-choice questions.	Serious game activities
Avşar et al. [18]	“Gimkit game” included picture questions, multiple-choice questions, matching questions, and classic questions.	Quiz-style game
Barner et al. [19]	An escape room where participants would work in small groups to make decisions regarding patient care to advance a total of 10 rooms.	Virtual escape room
Bayram et al. [20]	Students ensure that the nurse character performs tracheostomy care on a patient and records the results, following the procedural steps.	Mobile game-based VR application
Blanié et al. [21]	In the game, a nurse is expected to identify clinical deterioration in 4 different clinical situations and warn the medical team appropriately.	Simulation with serious game
Borges et al. [22]	Two educational activities were developed using AR-based games applied to home-visiting teaching.	AR-based game activities

Table 1. Cont.

Author	Short Game Description ¹	Basic Design Info ¹
Breitkreuz et al. [23]	The VR Sterile Urinary Catheter Insertion Game was created as a cost-effective way to practice sterile catheter insertion skills.	VR game
Buijs-Spanjers et al. [24]	“Delirium experience” game teaches how to improve care for delirious patients and provides insight into how nurses’ actions influence the patient.	Video-based serious game
Calik et al. [25]	Game promoting safe behaviors during the COVID-19 pandemic—game sequence included wearing personal protective equipment and recognizing COVID-19 symptoms.	Serious game
Calik et al. [26]	Players are nursing students who visit patients’ rooms and are given questions to select different options in the correct order.	Serious game
Capallera et al. [27]	Simulation of a blood sampling scenario, with the possibility to visualize contamination due to errors in hand disinfection and hygiene.	Immersive VR simulation
Cervi et al. [28]	Students cared for three simulated patients who required attention, requested medications, and questioned and reported their needs.	Computer simulation game
Chang et al. [29]	Game to teach sputum suction skills including in-game learning tasks like gathering information on the preparations for the sputum suction.	Role-playing game
Chang et al. [30]	The game character, a nursing student, needs to learn to interpret electrocardiogram waves to save others’ lives in different cases.	Role-playing game
Chang et al. [31]	Interactive animation where players’ nurse avatars treat a patient. The animation pauses and multiple-choice selections of possible dialog are displayed. Students must select the correct choice to proceed.	Online interactive animation
Chou [32]	Hospital ward scenarios with 4 learning tasks: self-introduction, nurse–patient relationship, interaction, and medical history collection.	VR simulation
Chow et al. [33]	The game simulated a mass casualty incident—students proceed with the triage tasks and assign priority to each casualty.	3D game-based virtual world
Craig et al. [34]	Players must follow a path to the finish line by responding to multiple-choice questions about dementia in a random sequence.	Serious game
da Silva et al. [35]	“Treat Well!” game teaches the treatment of a simple wound to nursing students using visual perception.	Serious game
Dubovi et al. [36]	Players are nurses in a virtual hospital collecting patients’ clinical data, discerning treatment plans, and conducting medication procedures.	VR-based simulation
Dubovi et al. [37]	In this simulation, students assess a patient’s clinical condition, interpret the physician’s orders, and prepare and administer the correct medication.	VR simulation
Dubovi et al. [38]	Student enters the simulated hospital ward as a nurse-avatar and is presented with different clinical scenarios/medical orders that require them apply their knowledge by administering medications to the patient.	Low immersive VR simulation
EL Machtani EL Idrissi et al. [39]	The game consists of 3 scenarios on pediatric nursing practices for which objectives to be achieved are specified.	Serious game

Table 1. Cont.

Author	Short Game Description ¹	Basic Design Info ¹
Erdoğan et al. [40]	In the game, students were nurses taking care of a baby in neonatal ICU, practicing tasks like positioning and non-nutritive breastfeeding.	Digital game
Farsi et al. [41]	Serious game with a virtual emergency scenario where the player has to save the life of a victim requiring cardiopulmonary resuscitation.	Serious game on smartphone platform
Gilardi et al. [42]	“Nursing XR” is a VR application with a wound-dressing scenario where the patient is discharged and requires follow-up care by a nurse.	VR application
Girão et al. [43]	In “NurseVR”, the player prepares and administers medication, while patient identification and hand hygiene simulations are also provided.	VR serious game
Gu et al. [44]	Players must follow the correct steps to complete flushing and locking of venous catheters with a pre-filled saline syringe.	Game-based mobile application
Gutiérrez-Puertas et al. [45]	The game consists of the appearance of life support keywords on the phone screen that the player must describe for teammates to guess.	Mobile application game
Hara et al. [46]	The player is immersed in the patient unit, a nurse avatar explains the clinical situation, and the player starts communicating with the patient.	Serious game in 3D immersive VR
Havola et al. [47]	Two kinds of simulation were used. In both, the student, as a nurse, played clinical scenarios, choosing multiple-choice options, and was given scores based on the actions they made or did not make.	Computer-based simulation game and a VR simulation
Hu et al. [48]	Disaster situations requiring intervention management decisions by players for standard cardiopulmonary resuscitation intervention.	VR mobile game-based app
Hu et al. [49]	COVID-19 game included wearing protective equipment tasks, diagnosing COVID-19 patients, and evaluating confirmed patients/assigning hospital beds.	Serious game-based computer app
Hwang et al. [50]	In the intravenous injection game, students decide on normal and abnormal intravenous injections in order to save patients’ lives.	Game-based flipped learning approach
Irwin et al. [51]	Students as nurse avatars in Second Life entered the virtual community Medical Centre and assessed patients academics.	3D VR simulation
Kardong-Edgren et al. [52]	Players refreshed sterile urinary catheterization skills by don sterile gloves, prepared catheter trays and supplies, and catheterized the torso.	VR game
Kayyali et al. [53]	“DOSE” game players are archetypal heroes, answering challenging questions to save students from a virus spreading on campus.	Serious game web application
Keys et al. [54]	Students play the role of a nurse caring for a patient in cardiac arrest, reinforcing key aspects of cardiovascular life-support algorithms.	Virtual simulation game
Kirkman et al. [55]	Gaming platform simulation scenario that transitioned standardized telehealth clients to the emergency care via a high-fidelity simulator.	Hybrid simulation in a gaming platform
Koivisto et al. [56]	Players interview and observe virtual patients and perform necessary nursing interventions. Every choice/action made by players is scored.	3D computer simulation game

Table 1. Cont.

Author	Short Game Description ¹	Basic Design Info ¹
Lau et al. [57]	Students interact with patients in immersive virtual clinical scenarios and perform procedures (in practice or assessment mode).	Immersive VR simulation
Lau et al. [58]	Players experienced a typical clinical session enabling and engaging them in executing virtual procedures.	Immersive VR simulation
Li et al. [59]	VSCERTS tool covers cognitive domains involved in elderly impairment. Tasks were presented in the form of games.	VR simulation
Lima et al. [60]	Player assumes the role of nurse in the vaccination room and answers questions on immunization—correct answers promote the nurse avatar.	Mobile serious game
Luckkar-Flude et al. [61]	4 video serious games about healthcare encounters with LGBTQI2S individuals. After each video, multiple-choice questions are posed.	Virtual simulation screen-based games
Ma et al. [62]	In “That Dragon, Cancer”, players experience a scene where parents are told that their child’s cancer is terminal from 4 different perspectives.	Computer role-playing game
Maheu-Cadotte et al. [63]	In “SIGN@L”, students build logical networks linking 2 acute heart failure concepts within 23 grids of varying dimensions. Each grid square is a different concept that may be part of the logical network.	Serious game
Mäkinen et al. [64]	Players assess critically ill patients with airway, breathing, circulation, disability, exposure approach (ABCDE approach) by choosing from multiple-choice menus.	Immersive VR simulation game
Masoumian Hosseini et al. [65]	Students as virtual avatars were introduced to 25 case studies promptly engaging with the virtual patients.	Simulation game
Masoumian Hosseini et al. [66]	A disaster-themed game of 25 scenarios organized into five categories. Student avatars could earn up to 20 points/coins for each scenario.	Serious game
Matias et al. [67]	Players check vital signs with multiple-choice questions and a hangman game. They also play memory and a Super Mario adaptation game.	Serious game
Mirzaei et al. [68]	The educational scenario included games such as multiple-choice questions, blank questions, matching, and hot spots.	Serious game
Nasiri et al. [69]	“PlaSurIn” teaches how to setup basic surgical instruments for minor surgeries. Game is played in virtual, learning, and assessment mode.	Serious game
Novoseltseva et al. [70]	In “CLONE”, players choose a case from the library and act as nurses who program patient care and make decisions under uncertainty/risks.	Simulation game
Novoseltseva et al. [71]	To complete the mission in “CLONE”, nurse students have to provide the required care for each patient according to their medical profiles.	Simulation game
Nurse-Clarke et al. [72]	Players are introduced to student Isabella and assist her with learning about medication errors by watching scenarios and answering questions.	Virtual game simulation
Ordu et al. [73]	A virtual game simulation designed on nursing students’ perception of nursing diagnoses and clinical practices.	Virtual game simulation
Ordu et al. [74]	Players choose from 20 scenarios for nursing diagnosis and goal setting and answer questions. Then, they prioritize 10 nursing diagnoses.	Virtual game simulation

Table 1. Cont.

Author	Short Game Description ¹	Basic Design Info ¹
Pons Lelardeux et al. [75]	“CLONE” supports the training of nursing students on scheduling skills, situation awareness, and decision-making using a virtual hospital.	Game-based simulation
Rodriguez-Ferrer et al. [76]	Digital escape rooms for severe mental illness. Teams were housed in a web-based workroom to share ideas about solving the escape room.	Web-based escape room
Rodriguez-Ferrer et al. [77]	In “No Memories”, escape room players are characters with severe mental illness and must remember who and where they are to escape.	Digital escape room
Rodriguez et al. [78]	Players in a virtual clinic are shown different health techniques via a VR simulation that must be learned and reproduced by the students.	Virtual Reality application
Roman et al. [79]	The game is set in an Intensive Care Unit, and the evolution of patients’ health was linked to the clinical decision the student had taken.	Serious game
Rosa-Castillo et al. [80]	Game aimed to give diet and nutrition tips to help astronauts choose adequate food to undertake activities. Participating students answered questions individually and solved weekly challenges in groups.	Instagram-based game
Rosa-Castillo et al. [81]	Game is set in a space station. Players gave diet advice to astronauts and responded to daily individual challenges/weekly group challenges.	Instagram-based game
Rosillo et al. [82]	Escape Room searching for a scientist fleeing with COVID-19 vaccine. Students must find it by passing missions related to mathematics.	Digital escape room
San Martín-Rodríguez et al. [83]	American Nurses Association Hall of Fame was the game’s setting. Goal was to reveal a “non-nurse” imposter who had infiltrated the Hall of Fame.	Serious game with Augmented Reality
Sarvan et al. [84]	Serious game simulation into neonatal resuscitation training to raise the students’ ventilation and compression performing skills.	Serious game simulation
Soyoof et al. [85]	The game familiarizes players with the skills and equipment commonly used by nurses using a first aid kit and administering life support.	Serious game
Suh et al. [86]	A nurse-character and a patient were displayed. The method of the game was carried out by dragging and dropping the order of a nursing skill.	Game-based mobile application
Tang et al. [87]	A game for practicing venous blood specimen collection. It requires participants to sort cards correctly within a specified time.	Game-based mobile application
Verkuyt et al. [88]	Players are presented with film clips of nurse–client scenarios, followed by options on how to proceed based on their clinical judgment.	Virtual simulation games
Verkuyt et al. [89]	The game is a branching scenario where actors depict a realistic clinical experience, and the user, through options, can control the pace of play.	Virtual simulation games
Volejnikova-Wenger et al. [90]	Players meet clients living in different settings and must critically think through situations to determine a variety of health and safety hazards.	Serious game
Wong et al. [91]	Students are required to analyze in-game situations and collaborate to select correct answers and demonstrate clinical competency.	Virtual serious game

Table 1. *Cont.*

Author	Short Game Description ¹	Basic Design Info ¹
Xie et al. [92]	Players practice cognitive assessment skills by interacting with an older person with dementia. Multinomial responses produce different scores.	Immersive VR simulation
Yang et al. [93]	To progress through escape room challenges, students had to identify and utilize the correct clues according to a maternal case scenario.	Online game-based escape room

¹ Provided data extracted from the abstract or method section of each article.

The first research question (Q1.1), was addressed through the presentation of the 81 articles in Table 1. The geographical distribution of publications (Q1.2) can be observed on the map in Appendix A (Figure A2). Overall, twenty countries from all five continents were identified. The countries with the most publications were Spain ($n = 10$), Turkey ($n = 9$), and China ($n = 8$). A thorough analysis of the exact number of articles each country yielded is available in the Appendix (Table A3).

To answer Q2.1, we excluded articles reporting on the same serious game in more than one publication during the understudy period (Appendix A, Table A4). Hence, upon eliminating 12 articles, we estimated that 69 distinct serious games have been developed. The decision to exclude multiple publications on the same serious game was also implemented during data analysis of Q2, Q3, and Q4 to avoid the risk of over-representing understudy variables. Subsequently, for Q2.2, the learning-type activities were analyzed for the 69 serious games. Game classifications included (1) simulations, (2) storytelling, (3) quizzes, (4) puzzles (escape rooms, card games, memory games, and matching games), (5) decision-making, (6) resource management, and (7) role-playing games. Several games incorporating multiple learning-type activities were classified into more than one category (Table 2). Simulation activities were the most common (42.0%). By simulation-type activities we are referring to game-based tasks that mimic real-world processes to provide players with practical experience within realistic interactive scenarios in a safe, risk-free environment. In addition, decision-making (33.3%) and puzzles (30.4%) were also popular.

Table 2. Serious games classification according to the type of learning activity/ies implemented.

Learning Activity Type	Frequency (%) N = 69	Studies References ¹
Simulation	28 (40.6)	[20,21,23,27,28,31,32,38,40,43,46,51,52,54,56,58,61,64,65,67,70,72,74,78,84,85,89,92]
Storytelling	5 (7.2)	[15,24,41,61,62]
Quiz	16 (23.2)	[15,17,18,25,34,41,43,45,53,54,60,61,67,68,74,89]
Puzzle	21 (30.4)	[14,16–18,21,22,26,33,35,44,45,55,59,63,67,77,82,83,86,87,93]
Decision-making	23 (33.3)	[13,19,22,28,30,31,35,38,39,42,43,54,56,64,65,70,72,78,79,81,89,90,92]
Resource management	6 (8.7)	[29,48,49,70,90,91]
Role-playing game	5 (7.2)	[29,30,32,50,62]

¹ Most recent publication per serious game was included.

For Q2.3, we classified serious games subjects into ten broad groups (Figure 2). The most common subject was “nursing clinical procedures and clinical practice skills” (33.3%), followed by “adult nursing care provision” (15.9%). Table A5 in the Appendix A presents all serious games teaching topics categorized by thematic group. Most articles (52.2%) did not report if the games were introduced within a specific curriculum course. Hence, to answer Q2.4, data was extracted from 33 articles (47.8%), and six categories similar to the

teaching topic groups were formulated (Table 3). As observed, most games were part of nursing fundamental courses ($n = 11$) or nursing clinical procedures–practices ($n = 7$).

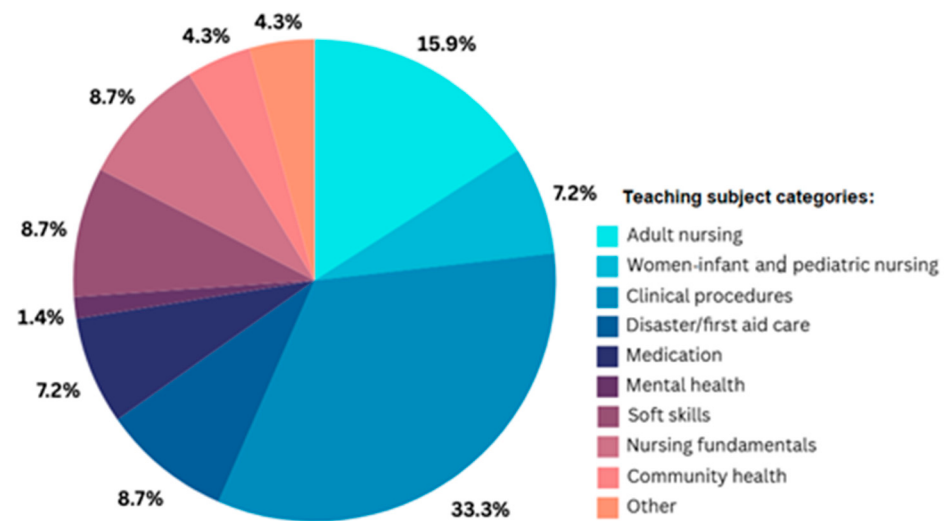


Figure 2. Distribution of nursing serious games per teaching subject category (N = 69).

Table 3. Nursing courses incorporating serious games categorized into thematic categories.

Course Categories	Curriculum Courses Including Serious Games as Learning Tools
Clinical procedures–clinical practice	(1) Clinical nursing, (2) semiology, semiotechnics, and care process, (3) clinical placement, (4) integrated practicum, (5) hospital nursing practice, (6) venous indwelling needle course, and (7) medical–surgical course
Adult nursing	(1) Geriatric nursing, (2) nursing for the older adult population, (3) dietetics and nutrition, (4) adult health clinical course, and (5) critical care
Women and infant care–pediatric nursing	(1) Maternity course, (2) pediatric nursing
Disaster/emergency/first aid care	(1) Emergency nursing care, (2) basic and advanced life support, (3) trauma and disaster nursing, (4) emergency and crisis management, and (5) help and rescue course
Nursing fundamentals and aligned core sciences	(1) Fundamentals of nursing practicum, (2) fundamentals of nursing, (3) fundamentals of nursing, (4) fundamentals of nursing, (5) fundamentals of nursing, (6) fundamentals of nursing II, (7) internal medicine, (8) nursing management, (9) pharmacology, (10) physiology, and (11) health assessment course
Other	(1) English course, (2) statistics and information systems, and (3) multiple courses including pain assessment, home assessment, and global citizens

To answer Q3.1, we analyzed all the data we could extract on serious game design information. Firstly, we investigated the different devices that serious games were developed for. According to the results, the following categories were created: (1) games developed for personal computers (PCs), (2) games designed for Head-Mounted Display (HMD) devices (including stand-alone HMDs, PC-HMDs, or mobile-HMD devices), (3) games created for mobile devices (including iPods, tablets, and mobile phones), and (4) games that were designed for both PC and mobile device use. For one publication, we could not extract the necessary info, therefore the category (5) “not specified” was added. Figure 3 presents findings per device category. Almost half of the nursing games (47.8%) were designed as PC serious games.

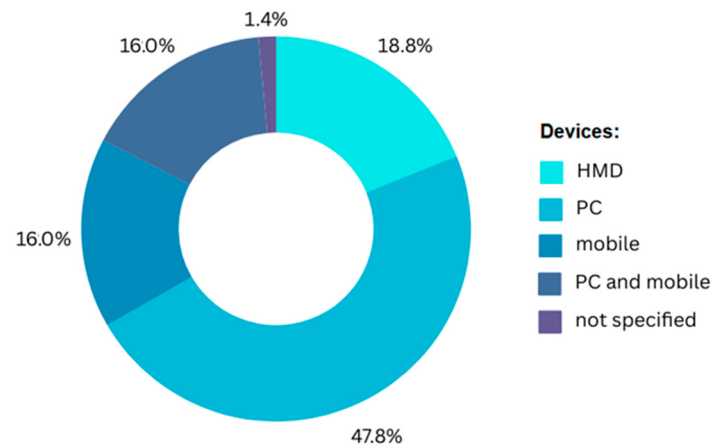


Figure 3. Most commonly utilized devices by nursing serious games (percentage distribution, N = 69).

HMD: Head-Mounted Display devices including stand-alone HMDs, PC-HMDs, or mobile-HMDs. Secondly, the technologies embarking on creating serious game environments (animation, graphics, interactive design, etc.) were examined to answer Q3.1. Data were grouped into the following categories: (1) two-dimensional—2D, (2) three-dimensional—3D, (3) Augmented Reality—AR, (4) Virtual Reality—VR, (5) Immersive Virtual Reality—IVR, and (6) other (including video simulations, google forms, social media platforms, etc.). Figure 4 shows that the most commonly reported technologies in nursing serious games in our sample were 2D (47.8%) and IVR (11.6%).

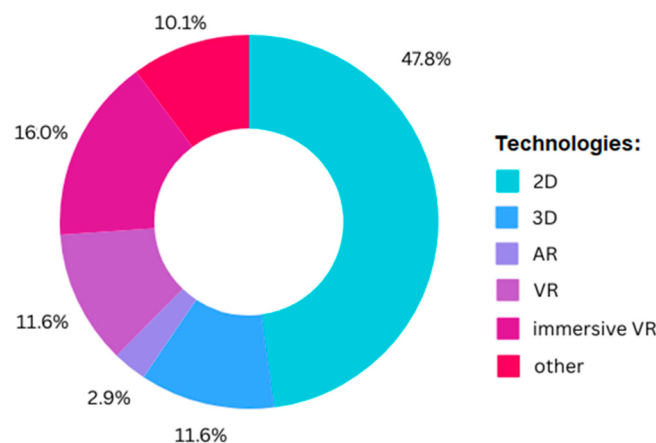


Figure 4. Technologies embarked by nursing serious games (percentage distribution, N = 69).

Additionally, to answer Q3.2, data analysis indicates that the majority of the games were designed as single-player games (79.8%). Only 10.1% of the games were multiplayer games, while another 10.1% of the games could be played as both single or multiplayer. Play mode was collaborative in 15.9% of the games, while competitive mode was present in 10.1% of the games. Few games (4.4%) presented elements of both collaboration and competition (players were collaborating as members of the same team to compete against other teams). However, the majority of the games (69.6%) were single-player games that did not incorporate either elements of collaboration or competition.

Regarding serious games' technical development, data were grouped into (1) game engines, (2) tools, (3) software frameworks/libraries, and (4) others. Relevant data was not provided by 36.2% of the articles. Genially was the most common tool ($n = 6$), while Unity was the most popular game engine ($n = 11$). Table 4 documents all development approaches. Furthermore, it is noteworthy that 54.6% of the games were created without

coding, 6.8% needed full-code development, and 38.6% required few programming skills (using intuitive drag-and-drop tools).

Table 4. Instruments used in nursing serious games development.

Development Approach	Instruments Used to Develop Nursing Serious Games
Tools	(1) Adobe Flash Professional CC and Adobe Flash CS6, (2) Adobe Flash, (3) Articulate, (4) Articulate Storyline 3, (5) Articulate, CAN-Sim, (6) Breakout EDUTM, (7) FLARAS tool, (8) Gather.town, (9) Genially, (10) Genially, (11) Genially, (12) Genially, (13) Genially, (15) Genially and HP reveal (15) Gimkit platform, (16) Macromedia Flash 8.0, (17) OpenSim, (18) Tumult Hype, and (19) VTS Editor Education version 2 platform
Game engines	(1) Cocos2D game engine, (2) Cocos2d-x game engine, (3) Construct engine, (4) Construct 2 engine, (5) RPG maker, (6) RPG MV maker, (7) Unity, (8) Unity, (9) Unity, (10) Unity, (11) Unity, (12) Unity, (13) Unity, (14) Unity, (15) Unity, (16) Unity, (17) Unity3D, and (18) Unreal Engine 5
Software frameworks	(1) Microsoft Asp.net Core, (2) .Net Core platform, and (3) .NET framework
Other	(1) Google slides, (2) Google forms, (3) Instagram, and (4) Second Life (virtual world)

Many games used multiple artifacts to achieve player–game interactions; thus, each game could be categorized into multiple groups. For the analysis, player–game interactions was grouped into: (1) controllers, (2) haptics (gloves, hand gestures), (3) gaze, (4) keyboard and/or mouse, (5) touchscreen, and (6) voice receptors. Two of the 69 articles did not report relevant data. The most popular interaction group was keyboard/mouse ($n = 46$) and touchscreen ($n = 23$), followed by controllers ($n = 7$) and haptic interaction ($n = 4$). Voice receptors ($n = 2$) and gaze ($n = 1$) were seldom used.

Additional data on key serious game design characteristics included game failure and feedback provisions. Failure was incorporated by 33.3% of the games when tasks were not successfully performed. Failure was not an option in 62.3% of the games, while in three games (4.4%) players could fail, but it is unclear whether they repeated the game. Furthermore, players' feedback provision, an important design element in educational serious games, was embodied in most games (53.6%), while in one game (1.4%) data was not clear. For 45.0% of the games, feedback was not provided during gameplay, or it was provided by the instructor verbally after the game.

To answer Q4.1, gamification elements were divided into (1) narrative (structured storyline), (2) score (points, success rate), (3) avatars (player or other game characters), (4) rewards (achievements, badges, and virtual currency), (5) quizzes, (6) time constraints (restriction to successfully complete a task), (7) game progress (progress bar, levels of different difficulty), (8) quests (journey towards a mission with side mini-tasks/challenges), and (9) leaderboards (player's performance ranking). Each game could present multiple gamification elements. Figure 5 portrays the number of nursing serious games displaying each gamification element. Keeping score ($n = 31$), utilizing avatars ($n = 30$), and incorporating a quest ($n = 30$) were most common. Out of the 69 serious games, one (1.4%) did not provide relevant information.

In addition, to further support the interpretation of the above findings, we propose a conceptual framework illustrating the potential connection between the emerged gamification elements and their contribution to key educational outcomes. The outcomes include cognitive domain (knowledge acquisition), psychomotor domain (skill development), and affective domain (learner satisfaction). Figure 6 provides a visual representation of how we perceive which specific game-based features influence different dimensions of learning.

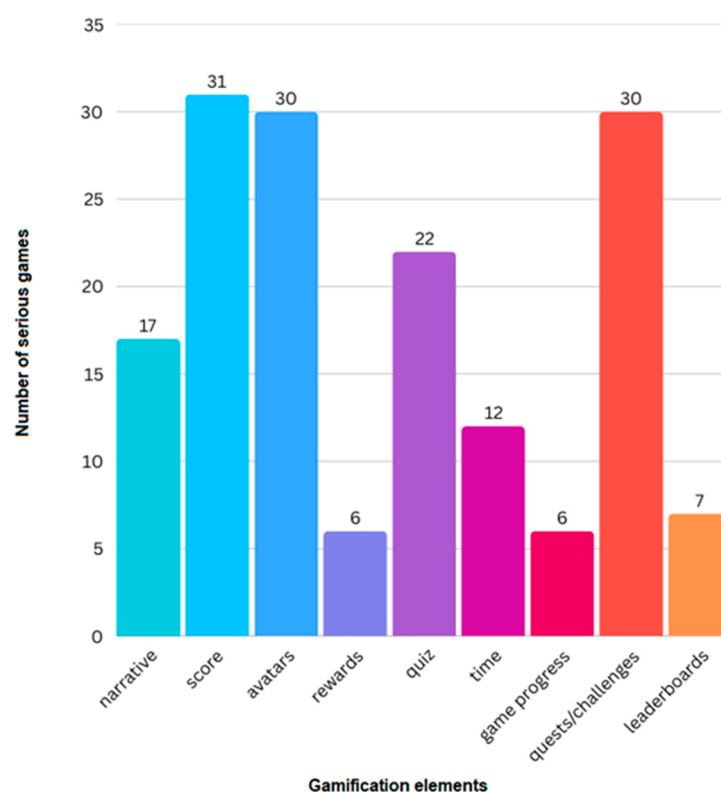


Figure 5. Common gamification elements of nursing serious games.

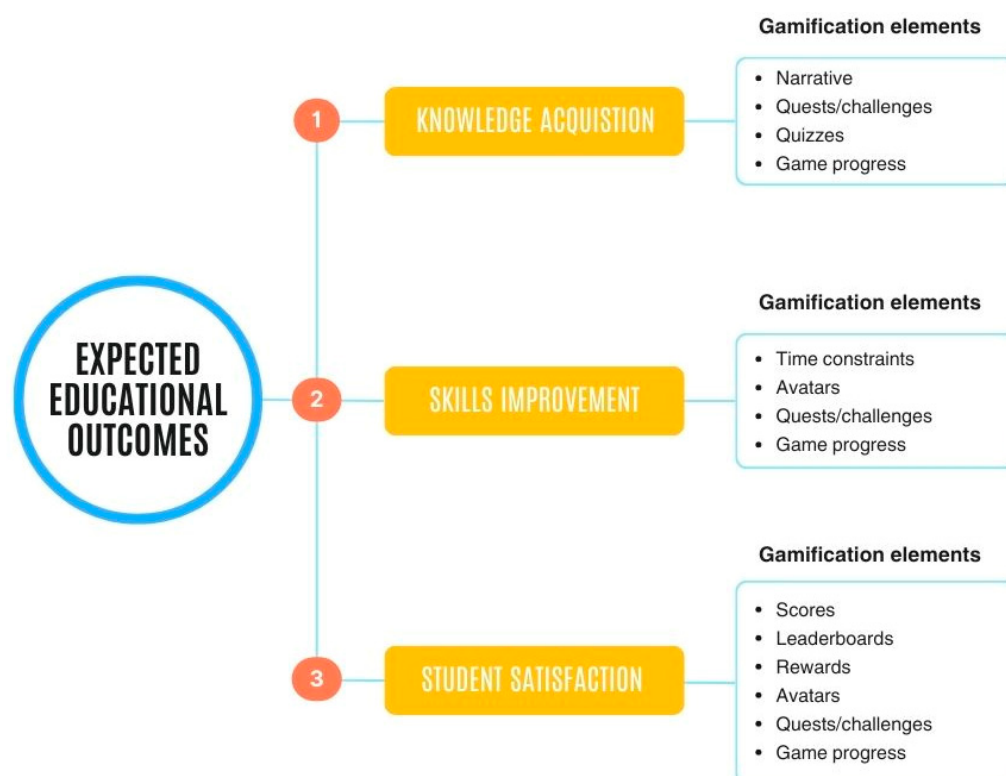


Figure 6. Conceptual framework connecting gamification elements to educational outcomes.

4. Discussion

The COVID-19 pandemic promoted innovative learning tools in all educational areas and settings with various digital technologies, such as serious games, gaining renewed interest [9,94]. A recent systematic review reporting on AR, VR, and MR serious games

presented a notable increase during 2020–2022 [9]. Healthcare education was not excluded from this trend [95]. Several reviews reported an increased number of digital educational tools for medical and nursing education [6,7,96,97]. The present study supports that nursing serious games rose significantly, with a four-fold increase observed in relevant publications between 2019 ($n = 6$) and 2023 ($n = 25$) and with a sharp increase being evident from 2021 and onwards.

Results revealed that twenty countries have implemented serious games into the curriculum in an attempt to revolutionize nursing education. The majority were in Europe and Asia (seven countries in each continent); however, most publications came from Asia ($n = 36$), followed by Europe ($n = 23$). This aligns with a study ranking Europe and Asia highest in designing health serious games, although in its sample, Europe's contribution was greater [9]. In our analysis, Spain led nursing serious games publications ($n = 10$), a fact supported by the literature [98,99]. Overall, the geographical distribution of nursing serious games indicated a middling global spread, with countries in Eastern Europe, Latin America, and Africa lacking initiatives. In general, countries that dominate serious games development typically combine technological capacity, research investment, and a skilled workforce, creating an ecosystem where serious games can bloom. On the other hand, resource/funding limitations, skills gaps, low awareness, and a lack of institutional support are key factors that hinder the development of serious games initiatives in many settings.

Simulation-based learning was the most popular (42.0%). This was expected, since nursing simulation games seem to act as facilitators for students integrating theory and practice to improve cognitive skills and readiness for clinical situations [100]. Following that, decision-making activities were frequently reported (33.3%). Given the significance of this soft skill in nursing, serious games enhancing the timely selection of the proper actions are considered of great importance [101]. Furthermore, both simulation and decision-making are related to the prevailing subject among the included games, which was “clinical procedures and practice”. There seems to be a notable association; several simulations are developed in an effort to enhance clinical reasoning in nursing students, especially post-pandemic [102,103], while clinical decision-making can be well practiced in the realistic and safe environment of serious games [104].

The COVID-19 pandemic also enabled several computerized systems in nursing education, like desktop-based systems, mobile apps, VR technology, and haptic interaction [97]. The above is supported by our findings, reporting a wide set of technologies, devices, and tools used to develop nursing serious games ranging from static content (2D) to IVR environments. More specifically, 2D technology was utilized by 47.8% of the games. This can be explained from both the developers' and users' perspective; 2D games are easier, cheaper, and faster to develop [105], while from the user's perspective, 2D games are more comprehensible for people not playing games often. Indeed, a study introducing a 3D game as a physics learning tool and comparing it with a 2D game reported that the 2D game induced a significantly higher learning gain for the participants [106].

VR technology was also frequently used by the included serious games (IVR 16.0%, VR 11.6%). Generally, VR technology has dominated nursing serious games in the past years [7]. However, a study comparing a gamified 2D, 3D, and IVR version of a healthcare educational application showed that, although participants believed that the IVR version helped the most to improve their performance, on exams, the highest scores were obtained by students using the 2D or 3D version [107]. Hence, it must be acknowledged that each technology bears unique characteristics that can effectively support different educational processes [7]. Furthermore, there are unlimited mechanisms for developing nursing serious games ranging from different depths of program utilization to the employment of game-delivering platforms, tools, and engines [108]. In our study, most nursing serious games

utilized tools like Genially and engines like Unity. It is also notable that most games were developed without coding. This further supports the previously underlined need for easy, fast solutions in serious game development.

The majority of games were designed as computer games; hence, the most popular player–game interaction was the keyboard/mouse followed by touchscreen (for mobile devices). Additionally, 18.8% of nursing serious games used HMD devices that simulate authentic clinical environments and are highly attractive to nursing students due to their immersive component [109]. Included HMD devices mainly utilized controller and haptic player–game interactions; however, HMDs often incorporate voice receptors and gaze. Generally, the higher the level of immersion in nursing serious games, the greater the multisensory simulation seems to be [110].

Moreover, gamification elements varied vastly across the enrolled studies. In the literature, frequently reported gamification elements are narrative, score, leaderboards, progress bars, rewards, badges, and quests [111,112]. In our study, the most popular were scoring, avatar utilization, and quests. Furthermore, quizzes, narratives, and time constraints were regularly embodied. These findings are in accordance with a previous study on nursing education serious games reporting that the most common gamification elements were scoring, challenges, avatars, and time restrictions [108].

Finally, while synthesizing the results, some gaps in the literature emerged that future research could address. Initially, a dialogue regarding the appropriateness of each technology (VR, AR, 2D, etc.) should open because people tend to believe that the newest is always the best. However, each technology bears a potential that can be effective in different ways. Appropriateness should be evaluated based on specific educational goals, targeted audiences, and available resources. A thoughtful discussion should prioritize evidence-based approaches, balancing innovation with practical considerations, ensuring that the chosen technology genuinely enhances learning outcomes for nursing students.

In addition, several serious games were applied for a limited period, especially VR and IVR games. According to a meta-analysis, significant improvement in nursing students' knowledge is shown when intervention time exceeds 2 weeks [7]. This highlights the need to conduct studies implementing extended serious games interventions to define the optimal duration for maximizing knowledge retention in nursing students. Future research could explore different intervention lengths to identify the threshold beyond which knowledge improvement plateaus and explore how integrating serious games into nursing curriculum over extended periods influences the overall academic performance, skills, and satisfaction of nursing students.

Limitations

Initially, reported information was mostly descriptive and varied significantly among the articles, while the understudy variables were not always provided, reducing the precision of the results and limiting the ability to make direct comparisons or draw strong assertions. To reduce missing data, sometimes we backtracked to previous publications reported by the authors or played the serious games (when links were provided) to confirm or extract additional information. To minimize the heterogeneity risk, we created broad variable groups based on scientific rationale, while allowing limited improvisation to enable reporting the data in more homogenous categories. In addition, there is a possibility of minor misinterpretations during the data extraction process due to the considerable number of results (N = 1969). However, since we followed a comprehensive research methodology trying to closely comply with PRISMA guidelines and reporting only data with an adequate set of information, the possibility of minor inaccuracies is not expected to have significantly impacted the reported results.

Furthermore, we should also stress the possibility of the following biases which may influence the interpretation and generalizability of the results: (1) As mentioned above, the uneven reporting standards across the included studies can lead to the selective representation of results, making it difficult to compare findings; (2) the lack of representation from certain regions or resource-limited countries may skew the evidence base, limiting the generalizability and equity of the findings; and (3) limited long-term studies may result in an overestimation on short-term outcomes. Hence, future research should also focus on developing and adopting standardized reporting frameworks, facilitate studies in under-represented geographic and socioeconomic contexts, and support designing longitudinal studies to track long-term impacts of serious games.

5. Conclusions

This study is an evidence-based review of the latest developments in the design, development, and implementation of nursing serious games aiming at enhancing the nursing curriculum. There are several ideas regarding nursing serious games' key design characteristics and prevalent gamification elements to facilitate interested stakeholders around the globe to invest in nursing serious games and inspire them to develop new, high-performing educational tools for nursing education. By reporting on the latest advancements and trends in the field, the authors aimed, through the analysis of the content and design methodology of the 69 distinct nursing serious games, to provide a useful blueprint that can enable both programmers and educators to easily grasp the idea of games logic and help them design and develop their own nursing serious games.

Author Contributions: Conceptualization, V.E.C. and N.V.; methodology, V.E.C., M.R., M.K. and N.V.; investigation, V.E.C.; formal analysis, V.E.C.; data curation, I.L., M.R., M.K. and N.V.; writing—original draft preparation, V.E.C.; writing—review and editing, I.L., M.R., M.K. and N.V.; visualization, V.E.C.; supervision, N.V. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: No new data were created or analyzed in this study. Data sharing is not applicable to this article.

Acknowledgments: Sifaki-Pistolla Dimitra is acknowledged for preparing the world diagram (Appendix A, Figure A2).

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

2D	Two-Dimensional
3D	Three-Dimensional
AR	Augmented Reality
HMD	Head Mounted Display
IVR	Immersive Virtual Reality
MR	Mixed Reality
PC	Personal Computer
Q	Question
VR	Virtual Reality

Appendix A

Table A1. Implemented search algorithms tailored for each database.

Database	Search Algorithm
PubMed	(“Nursing”[MeSH Terms] OR “Nurses”[MeSH Terms] OR “education, nursing”[MeSH Terms] OR “students, nursing”[MeSH Terms] OR “Nursing”[Title/ Abstract] OR (“nurs*”[Title/ Abstract] OR “nursing student*”[Title/ Abstract])) AND (“Education”[MeSH Terms] OR “Teaching”[MeSH Terms] OR “Learning”[MeSH Terms] OR “Training”[MeSH Terms] OR (“educat*”[Title/ Abstract] OR “train*”[Title/ Abstract] OR “instruct*”[Title/ Abstract] OR “teach*”[Title/ Abstract] OR “learn*”[Title/ Abstract] OR “student*”[Title/ Abstract] OR “undergraduate*”[Title/ Abstract])) AND (“Video Games”[MeSH Terms] OR “Mobile Applications”[MeSH Terms] OR “Virtual reality”[MeSH Terms] OR “Augmented reality”[MeSH Terms] OR “gaming”[Title/ Abstract] OR “game-based”[Title/ Abstract] OR “game based”[Title/ Abstract] OR “virtual reality”[Title/ Abstract] OR “augmented reality”[Title/ Abstract] OR (“serious gam*”[Title/ Abstract] OR “gamif*”[Title/ Abstract] OR “video gam*”[Title/ Abstract] OR “videogam*”[Title/ Abstract] OR “edugam*”[Title/ Abstract] OR “virtual gam*”[Title/ Abstract] OR “digital gam*”[Title/ Abstract] OR “computer gam*”[Title/ Abstract] OR “computer-based gam*”[Title/ Abstract] OR “mobile gam*”[Title/ Abstract] OR “game*”[Title/ Abstract] OR “simulation*”[Title/ Abstract] OR “mobile app*”[Title/ Abstract] OR “web-based gam*”[Title/ Abstract] OR “online gam*”[Title/ Abstract])) Filters: Case Reports, Clinical Study, Clinical Trials, Observational Study, Randomized Controlled Trial, English, from 2019–2023
Scopus	TITLE-ABS-KEY ((nurs*) AND (“seriou* gam*” OR “online gam*” OR “computer gam*” OR “computer-based gam*” OR “mobile gam*” OR “mobile app*” OR “web-based gam*” OR “game-based” OR “game based” OR “digital gam*” OR “digital games” OR “gamif*” OR “virtual reality” OR “augmented reality” OR “video gam*” OR “virtual gam*” OR “computer simulation*” OR “videogam*” OR “edugam*” OR gaming) AND (“educat*” OR “instruct*” OR “learn*” OR “student*” OR “undergraduate*” OR “teach*”)) AND (LIMIT-TO (PUBYEAR, 2022) OR LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2018)) 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”))

Table A2. Review process—excluding studies per review stage and year—final study sample.

Year of Publication ¹	Total Number of Studies	Excluded from Title	Excluded from Abstract	Excluded from Full Text	Included Studies
2023	472	203	128	116	25
2022	442	214	111	90	27
2021	431	217	89	109	16
2020	353	175	102	69	7
2019	271	168	53	44	6
Total	1969	977	483	428	81

¹ Year of publication is according to the e-pub release date which can differ from the actual publication date.

Table A3. Included studies per country.

Country	Number of Studies	Studies References
Australia	2	[51,90]
Brazil	7	[22,28,35,43,46,60,67]
Canada	5	[54,61,63,88,89]
Chile	1	[17]
China (including Hong Kong)	8	[33,44,48,49,59,87,91,92]

Table A3. *Cont.*

Country	Number of Studies	Studies References
Finland	3	[47,56,64]
France	4	[21,70,71,75]
Iran	7	[14,41,65,66,68,69,85]
Ireland	2	[13,34]
Israel	3	[36–38]
Morocco	1	[39]
Netherlands	1	[24]
Singapore	2	[57,58]
South Korea	1	[86]
Spain	10	[16,45,76–83]
Switzerland	1	[27]
Taiwan	6	[29–32,50,93]
Turkey (and North Cyprus)	9	[15,18,20,25,26,40,73,74,84]
United Kingdom	2	[42,53]
United States of America	6	[19,23,52,55,62,72]

Table A4. Studies utilizing the identical serious game and/or participant group.

Studies Utilizing the Same Serious Game	Studies Utilizing the Same Serious Game and Sample
[14,69]	
[36–38]	
[6,47]	[47,64]
[57,58]	
[65,66]	
[70,71,75]	[70,71]
[73,74]	
[76,77]	
[80,81]	
[88,89]	

Table A5. Nursing subjects grouped into thematic categories aligned with their teaching themes.

Thematic Categories	Nursing Subjects Targeted by the Included Serious Games
Clinical procedures–clinical practice	(1) intravenous therapy and subcutaneous injection procedures, (2) intravenous injection, (3) pre-clinical practices, (4) clinical nursing skills, (5) clinical judgment, (6) clinical reasoning skills, (7) clinical reasoning skills in a resuscitation situation, (8) clinical deterioration recognition, (9) clinical decision-making, (10) clinical decision-making, (11) electrocardiogram interpretation, (12) sputum suction, (13) objective structured clinical examination, (14) venous blood specimen collection, (15) asepsis training, (16) venous catheters, (17) sterile catheter insertion, (18) sterile urinary catheter training, (19) wound dressing, (20) wound treatment, (21) surgical instruments and equipment, (22) tracheostomy care, and (23) pressure ulcers
Adult nursing	(1) acute heart failure recognition and management, (2) diet and nutrition, (3) COVID-19 education, (4) COVID-19 care, (5) Alzheimer's/dementia knowledge, (6) care of older adults with dementia, (7) pain assessment, (8) care for delirious patients, (9) post-operative care, heart failure, and fluid volume overload, (10) rehabilitation, and (11) care of the acutely unwell

Table A5. Cont.

Thematic Categories	Nursing Subjects Targeted by the Included Serious Games
Women and infant care/pediatric nursing	(1) maternity-related knowledge, (2) assessment of prenatal client, (3) developmental care of infants in neonatal intensive care units, (4) neonatal resuscitation, and (5) pediatric nursing knowledge and skills
Medication	(1) medication preparation and administration, (2) medication administration, (3) medication errors, (4) cardiovascular pharmacology, and (5) pharmacology - use of the British National Formulary
Mental health	(1) mental health
Community health and primary care	(1) environmental hazard and safety assessment, (2) home visit, and (3) vaccination
Disaster/emergency/first aid care	(1) triage skills, (2) disaster evacuation management, (3) nursing principles in disaster situations, (4) life support techniques, (5) resuscitation, and (6) cardiopulmonary resuscitation
Nursing fundamentals and core assessment skills	(1) nursing models and theories, (2) nursing semiology and semiotics, (3) physiology, (4) knowledge/compliance of standard nursing precautions, (5) nursing diagnosis, goal setting, and diagnosis prioritization, and (6) nursing processes including assessment, diagnosis, planning, implementation, and evaluation
Soft skills	(1) empathy, (2) communication skills, (3) communication competence, (4) teamwork attitude enhancement, (5) cultural humility, and (6) non-technical skills including work scheduling, situation awareness, and decision-making
Other subjects	(1) English vocabulary, (2) mathematics, and (3) not specified

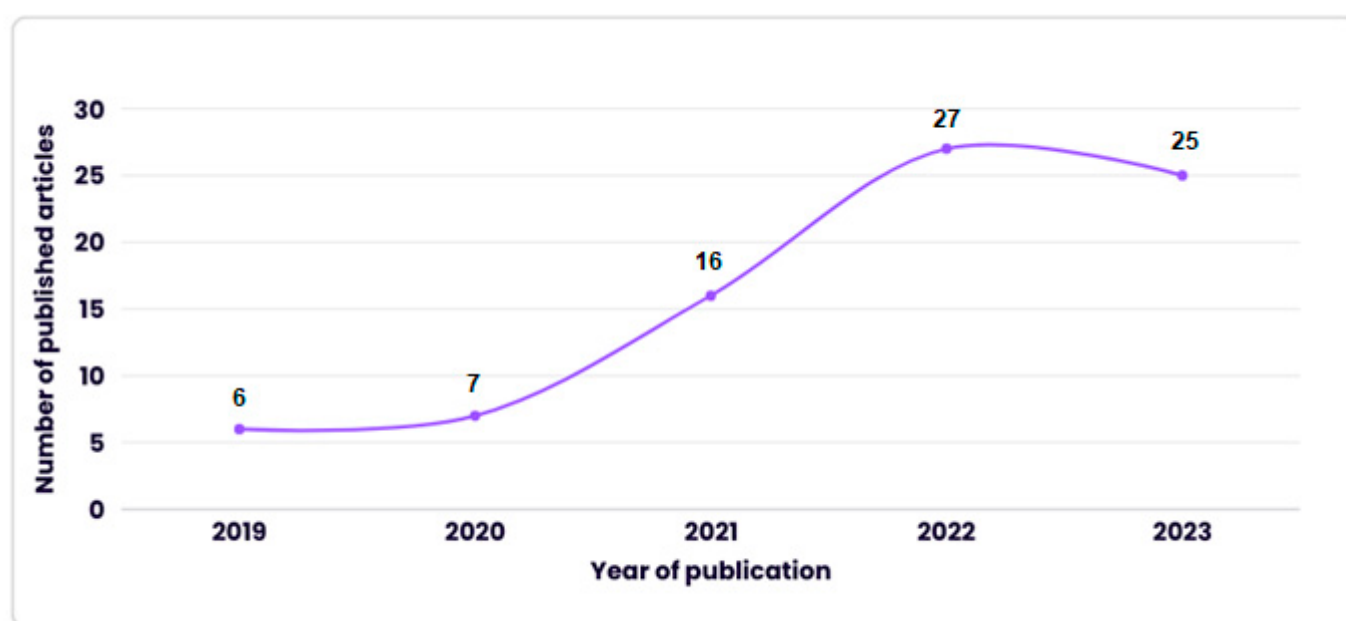


Figure A1. Number of studies emerged on undergraduate nursing serious games per year of publication.

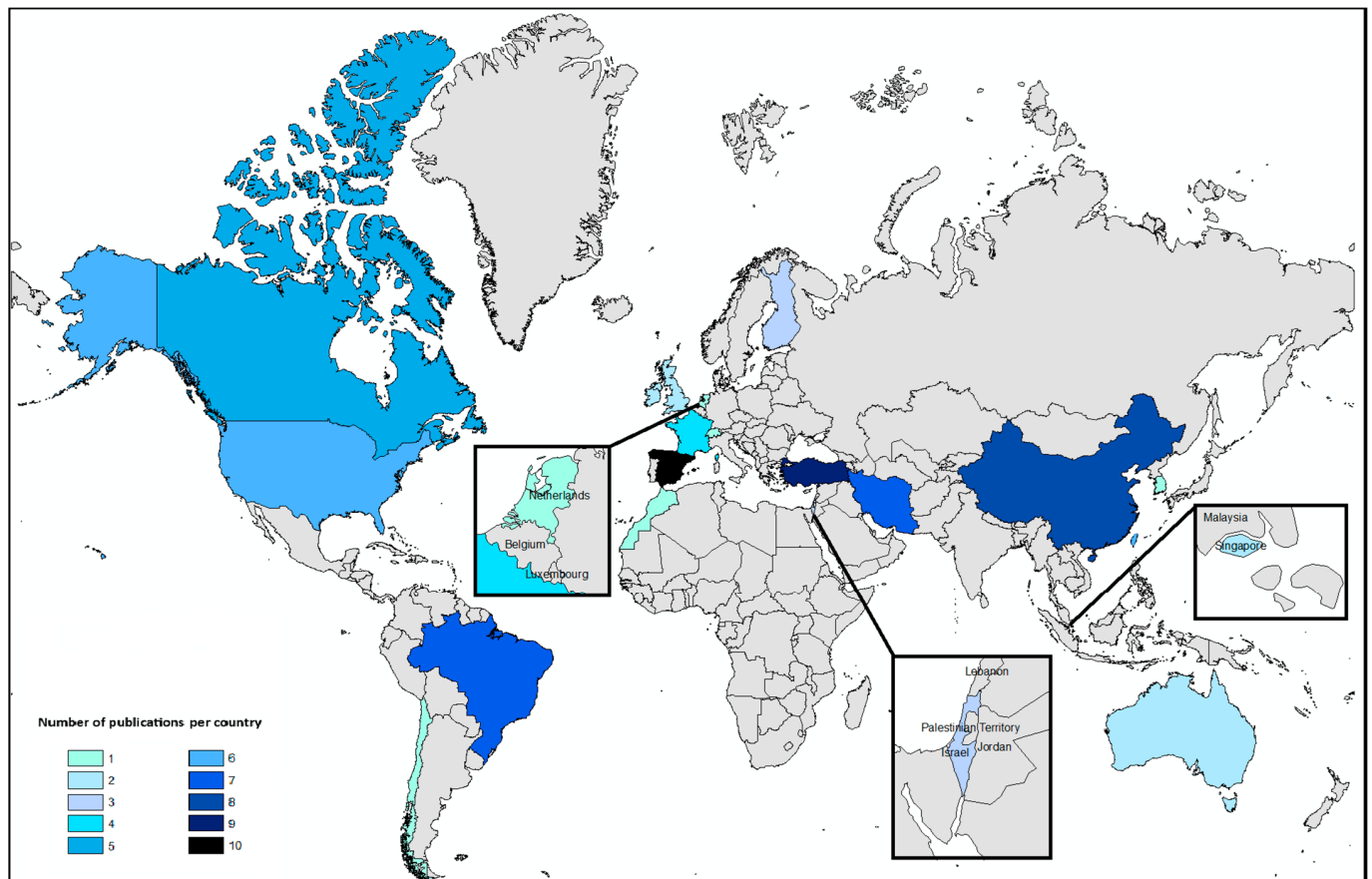


Figure A2. Number of studies emerged on undergraduate nursing serious games per country.

References

1. Schrader, C. Serious Games and Game-Based Learning. In *Handbook of Open, Distance and Digital Education*; Springer: Singapore, 2022; pp. 1–14. [\[CrossRef\]](#)
2. Alvarez, J.; Djaouti, D. An introduction to serious game definitions and concepts. In *Serious Games & Simulation for Risks Management, Proceedings of the Serious Games and Simulation for Risks Management Workshop, Paris, France, 5–7 December 2011*; LARSEN Science: Paris, France, 2011; pp. 11–15.
3. Barnabè, F.; Giorgino, M.C.; Guercini, J.; Bianciardi, C.; Mezzatesta, V. Engaging professionals with serious games: The Lean Healthcare Lab at Siena University Hospital. *Dev. Learn. Org.* **2017**, *31*, 7–10. [\[CrossRef\]](#)
4. Ullah, M.; Amin, S.U.; Munsif, M.; Safaev, U.; Khan, H.; Khan, S.; Ullah, H. Serious Games in Science Education. A Systematic Literature Review. *Virtual Real. Intell. Hardw.* **2022**, *4*, 189–209. [\[CrossRef\]](#)
5. Tori, A.A.; Tori, R.; Nunes, F.L.S. Serious Game Design in Health Education: A Systematic Review. *IEEE Trans. Learn. Technol.* **2022**, *15*, 827–846. [\[CrossRef\]](#)
6. Chatzea, V.E.; Logothetis, I.; Kalogiannakis, M.; Rovithis, M.; Vidakis, N. Digital Educational Tools for Undergraduate Nursing Education: A Review of Serious Games, Gamified Applications and Non-Gamified Virtual Reality Simulations/Tools for Nursing Students. *Information* **2024**, *15*, 410. [\[CrossRef\]](#)
7. Lee, M.; Shin, S.; Lee, M.; Hong, E. Educational outcomes of digital serious games in nursing education: A systematic review and meta-analysis of randomized controlled trials. *BMC Med. Educ.* **2024**, *24*, 1458. [\[CrossRef\]](#) [\[PubMed\]](#)
8. Thangavelu, D.P.; Tan, A.J.Q.; Cant, R.; Chua, W.L.; Liaw, S.Y. Digital serious games in developing nursing clinical competence: A systematic review and meta-analysis. *Nurse Educ. Today* **2022**, *113*, 105357. [\[CrossRef\]](#) [\[PubMed\]](#)
9. Lee, L.K.; Wei, X.; Chui, K.T.; Cheung, S.K.S.; Wang, F.L.; Fung, Y.C.; Lu, A.; Hui, Y.K.; Hao, T.; U, L.H.; et al. A Systematic Review of the Design of Serious Games for Innovative Learning: Augmented Reality, Virtual Reality, or Mixed Reality? *Electronics* **2024**, *13*, 890. [\[CrossRef\]](#)
10. Demircan, B.; Kiyak, Y.; Kaya, H. The effectiveness of serious games in nursing education: A meta-analysis of randomized controlled studies. *Nurse Educ. Today* **2024**, *142*, 106330. [\[CrossRef\]](#)

11. Sánchez-Valdeón, L.; Casado-Verdejo, I.; Barrionuevo, L.; Fernández-Martínez, E.; Liébana-Presa, C.; Pereira, R.; Gomes, L. Implementation of serious games in nursing student education: A systematic review. *Teach. Learn. Nurs.* **2024**, *19*, 60–67. [\[CrossRef\]](#)
12. Page, M.J.; McKenzie, J.E.; Bossuyt, P.M.; Boutron, I.; Hoffmann, T.C.; Mulrow, C.D.; Shamseer, L.; Tetzlaff, J.M.; Akl, E.A.; Brennan, S.E.; et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ* **2021**, *372*, n71. [\[CrossRef\]](#)
13. Adhikari, R.; Kydonaki, C.; Lawrie, J.; O'Reilly, M.; Ballantyne, B.; Whitehorn, J.; Paterson, R. A mixed-methods feasibility study to assess the acceptability and applicability of immersive virtual reality sepsis game as an adjunct to nursing education. *Nurse Educ. Today* **2021**, *103*, 104944. [\[CrossRef\]](#)
14. Akbari, F.; Nasiri, M.; Rashidi, N.; Zonoori, S.; Amirmohseni, L.; Eslami, J.; Torabizadeh, C.; Havaeji, F.S.; Bigdeli Shamloo, M.B.; Paim, C.P.P.; et al. Comparison of the effects of virtual training by serious game and lecture on operating room novices' knowledge and performance about surgical instruments setup: A multi-center, two-arm study. *BMC Med. Educ.* **2022**, *22*, 268. [\[CrossRef\]](#)
15. Al-Mugheed, K.; Bayraktar, N.; Al-Bsheish, M.; AlSyouf, A.; Aldhmadi, B.K.; Jarrar, M.; Alkhazali, M. Effectiveness of game-based virtual reality phone application and online education on knowledge, attitude and compliance of standard precautions among nursing students. *PLoS ONE* **2022**, *17*, e0275130. [\[CrossRef\]](#)
16. Antón-Solanas, I.; Rodríguez-Roca, B.; Urcola-Pardo, F.; Anguas-Gracia, A.; Satústegui-Dordá, P.J.; Echániz-Serrano, E.; Subirón-Valera, A.B. An evaluation of undergraduate student nurses' gameful experience whilst playing a digital escape room as part of a FIRST year module: A cross-sectional study. *Nurse Educ. Today* **2022**, *118*, 105527. [\[CrossRef\]](#)
17. Arias-Calderón, M.; Castro, J.; Gayol, S. Serious Games as a Method for Enhancing Learning Engagement: Student Perception on Online Higher Education during COVID-19. *Front. Psychol.* **2022**, *13*, 889975. [\[CrossRef\]](#)
18. Avşar, G.; Ozan, C.; Aydin, E. The effect of reinforcement using the Gimkit game on learning the subject in nursing students. *Nurse Educ. Pract.* **2023**, *68*, 103595. [\[CrossRef\]](#)
19. Barner, J.; Beer, R.; Edwards, T. Exploring the impact of escape rooms on clinical judgment to improve patient outcomes: A quality improvement project. *Teach. Learn. Nurs.* **2023**, *18*, 304–307. [\[CrossRef\]](#)
20. Bayram, S.B.; Caliskan, N. Effect of a game-based virtual reality phone application on tracheostomy care education for nursing students: A randomized controlled trial. *Nurse Educ. Today* **2019**, *79*, 25–31. [\[CrossRef\]](#) [\[PubMed\]](#)
21. Blanié, A.; Amorim, M.A.; Benhamou, D. Comparative value of a simulation by gaming and a traditional teaching method to improve clinical reasoning skills necessary to detect patient deterioration: A randomized study in nursing students. *BMC Med. Educ.* **2020**, *20*, 53. [\[CrossRef\]](#) [\[PubMed\]](#)
22. Borges, F.R.; da Costa, L.C.S.; Avelino, C.C.V.; de Freitas, L.A.; Kirner, C.; Goyata, S.L.T. Evaluation of an educational technology using augmented reality for home visiting teaching. *Enferm. Uerj.* **2019**, *27*, e37485. [\[CrossRef\]](#)
23. Breitzkreuz, K.R.; Kardong-Edgren, S.; Gilbert, G.E.; DeBlicke, C.; Maske, M.; Hallock, C.; Lanzara, S.; Parrish, K.; Rossler, K.; Turkelson, C.; et al. A multi-site study examining the usability of a virtual reality game designed to improve retention of sterile catheterization skills in nursing students. *Simul. Gaming* **2021**, *52*, 169–184. [\[CrossRef\]](#)
24. Buijs-Spanjers, K.R.; Harmsen, A.; Hegge, H.H.; Spook, J.E.; de Rooij, S.E.; Jaarsma, D.A.D.C. The influence of a serious game's narrative on students' attitudes and learning experiences regarding delirium: An interview study. *BMC Med. Educ.* **2020**, *20*, 289. [\[CrossRef\]](#) [\[PubMed\]](#)
25. Calik, A.; Cakmak, B.; Kapucu, S.; Inkaya, B. The effectiveness of serious games designed for infection prevention and promotion of safe behaviors of senior nursing students during the COVID-19 pandemic. *Am. J. Infect. Control* **2022**, *50*, 1360–1367. [\[CrossRef\]](#) [\[PubMed\]](#)
26. Calik, A.; Kapucu, S. The Effect of Serious Games for Nursing Students in Clinical Decision-Making Process: A Pilot Randomized Controlled Trial. *Games Health J.* **2022**, *11*, 30–37. [\[CrossRef\]](#)
27. Capallera, M.; Angelini, L.; Favre, A.; Magnin, F.; De Vito Woods, M.; Abou Khaled, O.; Mugellini, E. Training nurses in VR: Exploring spatial mapping and free-hand interaction. In Proceedings of the 34th Conference on l'Interaction Humain-Machine (IHM '23), Troyes, France, 3–6 April 2023; Association for Computing Machinery: New York, NY, USA, 2023; pp. 1–10. [\[CrossRef\]](#)
28. Cervi, G.H.; Somensi, R.M.; Caregnato, R.C.A.; Antunes Lima, A.A.; Respício, A.; Flores, C.D. Project and Preliminary Evaluation of SimHosp, a Tool for Decision Making in Nursing. *Stud. Health Technol. Inform.* **2019**, *264*, 541–545. [\[CrossRef\]](#)
29. Chang, C.Y.; Chung, M.H.; Yang, J.C. Facilitating nursing students' skill training in distance education via online game-based learning with the watch-summarize-question approach during the COVID-19 pandemic: A quasi-experimental study. *Nurse Educ. Today* **2022**, *109*, 105256. [\[CrossRef\]](#)
30. Chang, C.Y.; Kao, C.H.; Hwang, G.J.; Lin, F.H. From experiencing to critical thinking: A contextual game-based learning approach to improving nursing students' performance in Electrocardiogram training. *Educ. Tech. Res. Dev.* **2020**, *68*, 1225–1245. [\[CrossRef\]](#)
31. Chang, Y.Y.; Chao, L.F.; Xiao, X.; Chien, N.H. Effects of a simulation-based nursing process educational program: A mixed-methods study. *Nurse Educ. Pract.* **2021**, *56*, 103188. [\[CrossRef\]](#)

32. Chou, C.H.; Tai, H.C.; Chen, S.L. The effects of introducing virtual reality communication simulation in students' learning in a fundamentals of nursing practicum: A pragmatic randomized control trials. *Nurse Educ. Pract.* **2024**, *74*, 103837. [\[CrossRef\]](#)
33. Chow, M.C.M.; Hung, M.S.Y.; Chu, J.W.K.; Lam, S.K.K. Factors affecting nursing students' intention to use a 3D game to learn field triage skills: A structural equation modelling analysis. *BMC Nurs.* **2022**, *21*, 46. [\[CrossRef\]](#)
34. Craig, S.; Stark, P.; Wilson, C.B.; Carter, G.; Clarke, S.; Mitchell, G. Evaluation of a dementia awareness game for undergraduate nursing students in Northern Ireland: A Pre-/Post-Test study. *BMC Nurs.* **2023**, *22*, 177. [\[CrossRef\]](#)
35. Silva, G.C.; Silva, L.P.F.; Jofilsan, N.C.; Correia, W.F.M.; Gomes, A.S.; Campos Filho, A.S. Satisfaction Analysis for Using Educational Serious Games for Teaching Wound Treatment. In *Advances in Usability, User Experience and Assistive Technology. AHFE 2018, Proceedings of the International Conference on Applied Human Factors and Ergonomics, Orlando, FL, USA, 21–25 July 2018*; Ahram, T., Falcão, C., Eds.; Advances in Intelligent Systems and Computing 2019; Springer: Cham, Switzerland, 2019; Volume 794. [\[CrossRef\]](#)
36. Dubovi, I. Cognitive and emotional engagement while learning with VR: The perspective of multimodal methodology. *Comput. Educ.* **2022**, *183*, 104495. [\[CrossRef\]](#)
37. Dubovi, I. Learning with virtual reality simulations: Direct versus vicarious instructional experience. *Interact. Learn. Environ.* **2022**, *31*, 6627–6639. [\[CrossRef\]](#)
38. Dubovi, I.; Itzhaki, M. Playing the Role of a Nurse in a Virtual Reality Simulation: A Safe Environment for Emotion Management. *Nurse Educ.* **2023**, *48*, 13–18. [\[CrossRef\]](#) [\[PubMed\]](#)
39. Idrissi, W.E.M.E.; Chems, G.; Kababi, K.E.; Radid, M. The Impact of Serious Game on the Nursing Students' Learning, Behavioral Engagement, and Motivation. *Int. J. Emerg. Technol. Learn. (IJET)* **2022**, *17*, 18–35. [\[CrossRef\]](#)
40. Erdoğan, Ç.; Turan, T. Evaluation of the Effectiveness of Digital Game-Based Learning Given to Nursing Students for the Developmental Care of Infants in Neonatal Intensive Care Unit. *Comput. Inform. Nurs. CIN* **2023**, *41*, 300–308. [\[CrossRef\]](#)
41. Farsi, Z.; Yazdani, M.; Butler, S.C.; Nezamzadeh, M.; Mirlashari, J. Comparative Effectiveness of Simulation versus Serious Game for Training Nursing Students in Cardiopulmonary Resuscitation: A Randomized Control Trial. *Int. J. Comput. Games Technol.* **2021**, *2021*, 6695077. [\[CrossRef\]](#)
42. Gilardi, M.; Honnan, S.; Sheerman, L.; Cund, A.; Rae, S. Nursing XR—A VR application to teach decision making to student nurses. In *Proceedings of the 16th European Conference on Games Based Learning, Lisbon, Portugal, 6–7 October 2022*. [\[CrossRef\]](#)
43. Girão, A.L.A.; Dos Santos, M.N.O.; Chaves, E.M.C.; Gomes, E.B.; Oliveira, S.K.P.; Carvalho, R.E.F.L. NurseVR: Development of a Serious Virtual Reality Game for Medication Preparation and Administration Training. *Comput. Inform. Nurs. CIN* **2023**, *41*, 223–229. [\[CrossRef\]](#)
44. Gu, R.; Wang, J.; Zhang, Y.; Li, Q.; Wang, S.; Sun, T.; Wei, L. Effectiveness of a game-based mobile application in educating nursing students on flushing and locking venous catheters with pre-filled saline syringes: A randomized controlled trial. *Nurse Educ. Pract.* **2022**, *58*, 103260. [\[CrossRef\]](#)
45. Gutiérrez-Puertas, L.; García-Viola, A.; Márquez-Hernández, V.V.; Garrido-Molina, J.M.; Granados-Gámez, G.; Aguilera-Manrique, G. Guess it (SVUAL): An app designed to help nursing students acquire and retain knowledge about basic and advanced life support techniques. *Nurse Educ. Pract.* **2021**, *50*, 102961. [\[CrossRef\]](#) [\[PubMed\]](#)
46. Hara, C.Y.N.; Goes, F.D.S.N.; Camargo, R.A.A.; Fonseca, L.M.M.; Aredes, N.D.A. Design and evaluation of a 3D serious game for communication learning in nursing education. *Nurse Educ. Today* **2021**, *100*, 104846. [\[CrossRef\]](#)
47. Havola, S.; Haavisto, E.; Mäkinen, H.; Engblom, J.; Koivisto, J.M. The Effects of Computer-Based Simulation Game and Virtual Reality Simulation in Nursing Students' Self-evaluated Clinical Reasoning Skills. *Comput. Inform. Nurs. CIN* **2021**, *39*, 725–735. [\[CrossRef\]](#)
48. Hu, H.; Lai, X.; Li, H.; Nyland, J. Teaching Disaster Evacuation Management Education to Nursing Students Using Virtual Reality Mobile Game-Based Learning. *Comput. Inform. Nurs. CIN* **2022**, *40*, 705–710. [\[CrossRef\]](#)
49. Hu, H.; Lai, X.; Yan, L. Improving Nursing Students' COVID-19 Knowledge Using a Serious Game. *Comput. Inform. Nurs. CIN* **2022**, *40*, 285–289. [\[CrossRef\]](#)
50. Hwang, G.J.; Chang, C.Y. Facilitating decision-making performances in nursing treatments: A contextual digital game-based flipped learning approach. *Interact. Learn. Environ.* **2023**, *31*, 156–171. [\[CrossRef\]](#)
51. Irwin, P.; Coutts, R.; Graham, I. Looking Good Sister! The Use of a Virtual World to Develop Nursing Skills. In *Intersections in Simulation and Gaming: Disruption and Balance. Proceedings of the Australasian Simulation Congress 2019, Gold Coast, QLD, Australia, 2–5 September 2019*; Naweed, A., Bowditch, L., Sprick, C., Eds.; Communications in Computer and Information Science 2019; Springer: Singapore, 2019; Volume 1067. [\[CrossRef\]](#)
52. Kardong-Edgren, S.; Breitzkreuz, K.; Werb, M.; Foreman, S.; Ellertson, A. Evaluating the Usability of a Second-Generation Virtual Reality Game for Refreshing Sterile Urinary Catheterization Skills. *Nurse Educ.* **2019**, *44*, 137–141. [\[CrossRef\]](#)
53. Kayyali, R.; Wells, J.; Rahmtullah, N.; Tahsin, A.; Gafoor, A.; Harrap, N.; Nabhani-Gebara, S. Development and evaluation of a serious game to support learning among pharmacy and nursing students. *Curr. Pharm. Teach. Learn.* **2021**, *13*, 998–1009. [\[CrossRef\]](#) [\[PubMed\]](#)

54. Keys, E.; Luctkar-Flude, M.; Tyerman, J.; Sears, K.; Woo, K. The integration of virtual simulation gaming into undergraduate nursing resuscitation education: A pilot randomised controlled trial. *Clin. Simul. Nurs.* **2021**, *54*, 54–61. [\[CrossRef\]](#)
55. Kirkman, T.; Brown, N.; DeFoor, M.; Seay, A.; Darby, W. Enriching Nursing Simulation with a Threefold Hybrid Approach. *Clin. Simul. Nurs.* **2022**, *68*, 34–41. [\[CrossRef\]](#)
56. Koivisto, J.M.; Havola, S.; Engblom, J.; Buure, T.; Rosqvist, K.; Haavisto, E. Nursing Students' Scenario Performance: Game Metrics in a Simulation Game. *Nurs. Educ. Perspect.* **2023**, *44*, 222–228. [\[CrossRef\]](#) [\[PubMed\]](#)
57. Lau, S.T.; Liaw, S.Y.; Loh, W.L.; Schmidt, L.T.; Yap, J.; Lim, F.P.; Ang, E.; Jiat, C.; Siah, R. Mid-career switch nursing students' perceptions and experiences of using immersive virtual reality for clinical skills learning: A mixed methods study. *Nurse Educ. Today* **2023**, *124*, 105760. [\[CrossRef\]](#) [\[PubMed\]](#)
58. Lau, S.T.; Siah, R.C.J.; Dzakirin Bin Rusli, K.; Loh, W.L.; Yap, J.Y.G.; Ang, E.; Lim, F.P.; Liaw, S.Y. Design and Evaluation of Using Head-Mounted Virtual Reality for Learning Clinical Procedures: Mixed Methods Study. *JMIR Serious Games* **2023**, *11*, e46398. [\[CrossRef\]](#)
59. Li, G.; Gao, L.; Yin, H.; Jia, Y.; Zhang, X.; Tian, H.; Zheng, L.; Qiu, Y.; Li, X.; Chen, L. Implementation and Evaluation of a Virtual Reality-Based Cognitive Assessment and Rehabilitation Simulation Course in Undergraduate Nursing Students: A Pre-Post Study. *Clin. Simul. Nurs.* **2023**, *81*, 101430. [\[CrossRef\]](#)
60. Lima, I.D.A.; Ponce de Leon, C.G.R.M.; Ribeiro, L.M.; Silva, I.C.R.D.; Vilela, D.M.; Fonseca, L.M.M.; Góes, F.D.S.N.; Funghetto, S.S. A Serious Game (Immunitates) About Immunization: Development and Validation Study. *JMIR Serious Games* **2022**, *10*, e30738. [\[CrossRef\]](#)
61. Luctkar-Flude, M.; Ziegler, E.; Foronda, C.; Walker, S.; Tyerman, J. Impact of Virtual Simulation Games to Promote Cultural Humility Regarding the Care of Sexual and Gender Diverse Persons: A Multi-Site Pilot Study. *Clin. Simul. Nurs.* **2022**, *71*, 146–158. [\[CrossRef\]](#)
62. Ma, Z.; Huang, K.T.; Yao, L. Feasibility of a Computer Role-Playing Game to Promote Empathy in Nursing Students: The Role of Immersiveness and Perspective. *Cyberpsychol. Behav. Soc. Netw.* **2021**, *24*, 750–755. [\[CrossRef\]](#) [\[PubMed\]](#)
63. Maheu-Cadotte, M.A.; Dubé, V.; Lavoie, P. Development and Contribution of a Serious Game to Improve Nursing Students' Clinical Reasoning in Acute Heart Failure: A Multimethod Study. *Comput. Inform. Nurs. CIN* **2023**, *41*, 410–420. [\[CrossRef\]](#)
64. Mäkinen, H.; Haavisto, E.; Havola, S.; Koivisto, J.M. Graduating nursing students' user experiences of the immersive virtual reality simulation in learning—A qualitative descriptive study. *Nurs. Open* **2023**, *10*, 3210–3219. [\[CrossRef\]](#)
65. Masoumian Hosseini, M.; Masoumian Hosseini, S.T.; Qayumi, K.; Hosseinzadeh, S.; Ahmady, S. Crossover design in triage education: The effectiveness of simulated interactive vs. routine training on student nurses' performance in a disaster situation. *BMC Res. Notes* **2023**, *16*, 313. [\[CrossRef\]](#)
66. Masoumian Hosseini, M.; Masoumian Hosseini, T.; Qayumi, K.; Baeradeh, N. Game-based vs. Case-based Training for Increasing Knowledge and Behavioral Fluency of Nurse Students Regarding Crisis and Disaster Management; a Quasi-Experimental Study. *Arch. Acad. Emerg. Med.* **2022**, *10*, e77. [\[CrossRef\]](#) [\[PubMed\]](#)
67. Matias, L.D.M.; Celestino, M.N.S.; Carvalho, M.A.P.; Gouveia, B.L.A.; Ginú, I.L.N.; Costa, M.M.L.; Andrade, L.L. Semio em Jogo®: Development and evaluation of a playful-educational technology for nursing education. *Texto Contexto Enferm.* **2023**, *32*, e20220324. [\[CrossRef\]](#)
68. Mirzaei, S.; Mosalanejad, L.; Atashpour, S.; Bazrafcan, L. Gamification in Cardiovascular Pharmacology Course as Real Work Simulation by Case on Medical Sciences. *Pak. J. Med. Health Sci.* **2021**, *14*, 1751–1757.
69. Nasiri, M.; Eslami, J.; Rashidi, N.; Paim, C.P.P.; Akbari, F.; Torabizadeh, C.; Havaeji, F.S.; Goldmeier, S.; Abbasi, M. "Playing with Surgical Instruments (PlaSurIn)" game to train operating room novices how to set up basic surgical instruments: A validation study. *Nurse Educ. Today* **2021**, *105*, 105047. [\[CrossRef\]](#) [\[PubMed\]](#)
70. Novoseltseva, D.; Pons Lelardeux, C.; Jessel, N. Examining Students' Behavior in a Digital Simulation Game for Nurse Training. *Int. J. Serious Games* **2022**, *9*, 3–24. [\[CrossRef\]](#)
71. Novoseltseva, D.; Pons Lelardeux, C.; Jessel, N. Factors Affecting Success in a Digital Simulation Game for Nurse Training. In *Games and Learning Alliance. Proceedings of the International Conference on Games and Learning Alliance 2020, Laval, France, 9–10 December 2020*; Marfisi-Schottman, I., Bellotti, F., Hamon, L., Klemke, R., Eds.; Lecture Notes in Computer Science 2020; Springer: Cham, Switzerland, 2020; Volume 12517. [\[CrossRef\]](#)
72. Nurse-Clarke, N.; Hernandez-Acevedo, B. An Investigation of the Effects of Virtual Gaming Simulation with Enhanced Gaming Elements: A Pilot Study. *J. Interact. Learn. Res.* **2023**, *34*, 455–474. [\[CrossRef\]](#)
73. Ordu, Y.; Çalışkan, N. The effect of virtual game simulation on students' perception of nursing diagnosis and clinical practice: Post-test only randomized controlled trial. *Nurse Educ. Pract.* **2023**, *72*, 103792. [\[CrossRef\]](#)
74. Ordu, Y.; Çalışkan, N. The effects of virtual gaming simulation on nursing students' diagnosis, goal setting, and diagnosis prioritization: A randomized controlled trial. *Nurse Educ. Pract.* **2023**, *68*, 103593. [\[CrossRef\]](#)

75. Pons Lelardeux, C.; Galaup, M.; Pingaud, H.; Mercadier, C.; Lagarrigue, P. A Method to Balance Educational Game Content and Lesson Duration: The Case of a Digital Simulation Game for Nurse Training. In *The Impact of the 4th Industrial Revolution on Engineering Education. Proceedings of the International Conference on Interactive Collaborative Learning 2019, Bangkok, Thailand, 25–28 September 2019*; Auer, M., Hortsch, H., Sethakul, P., Eds.; Advances in Intelligent Systems and Computing 2020; Springer: Cham, Switzerland, 2020; Volume 1134. [\[CrossRef\]](#)
76. Rodríguez-Ferrer, J.M.; Manzano-León, A.; Cangas, A.J.; Aguilar-Parra, J.M. A Web-Based Escape Room to Raise Awareness About Severe Mental Illness Among University Students: Randomized Controlled Trial. *JMIR Serious Games* **2022**, *10*, e34222. [\[CrossRef\]](#) [\[PubMed\]](#)
77. Rodríguez-Ferrer, J.M.; Manzano-León, A.; Fernández-Jiménez, C.; Aguilar-Parra, J.M.; Cangas, A.J.; Luque de la Rosa, A. The use of digital escape rooms in nursing education. *BMC Med. Educ.* **2022**, *22*, 901. [\[CrossRef\]](#)
78. Rodríguez, S.M.; Parrilla, M.F.; Álvarez-García, V.; Pérez-Pérez, J.R.; Fernández-Álvarez, M.D.M.; Martín-Payo, R. Assessment of preclinical learning using virtual reality based education for nursing students. *Educ. Media Int.* **2023**, *60*, 209–223. [\[CrossRef\]](#)
79. Roman, P.; Ruiz-Gonzalez, C.; Rodríguez-Arrastia, M.; Granero-Molina, J.; Fernández-Sola, C.; Hernández-Padilla, J.M. A serious game for online-based objective structured clinical examination in nursing: A qualitative study. *Nurse Educ. Today* **2022**, *109*, 105246. [\[CrossRef\]](#)
80. Rosa-Castillo, A.; García-Pañella, O.; Maestre-Gonzalez, E.; Pulpón-Segura, A.; Roselló-Novella, A.; Solà-Pola, M. Gamification on Instagram: Nursing students' degree of satisfaction with and perception of learning in an educational game. *Nurse Educ. Today* **2022**, *118*, 105533. [\[CrossRef\]](#) [\[PubMed\]](#)
81. Rosa-Castillo, A.; García-Pañella, O.; Roselló-Novella, A.; Maestre-Gonzalez, E.; Pulpón-Segura, A.; Icart-Isern, T.; Solà-Pola, M. The effectiveness of an Instagram-based educational game in a Bachelor of Nursing course: An experimental study. *Nurse Educ. Pract.* **2023**, *70*, 103656. [\[CrossRef\]](#)
82. Rosillo, N.; Montes, N. Escape Room Dual Mode Approach to Teach Maths during the COVID-19 Era. *Mathematics* **2021**, *9*, 2602. [\[CrossRef\]](#)
83. San Martín-Rodríguez, L.; Escalada-Hernández, P.; Soto-Ruiz, N. A themed game to learn about nursing theories and models: A descriptive study. *Nurse Educ. Pract.* **2020**, *49*, 102905. [\[CrossRef\]](#) [\[PubMed\]](#)
84. Sarvan, S.; Efe, E. The effect of neonatal resuscitation training based on a serious game simulation method on nursing students' knowledge, skills, satisfaction and self-confidence levels: A randomized controlled trial. *Nurse Educ. Today* **2022**, *111*, 105298. [\[CrossRef\]](#)
85. Soyoo, A.; Reynolds, B.L.; Shadiev, R.; Vazquez-Calvo, B. A mixed-methods study of the incidental acquisition of foreign language vocabulary and healthcare knowledge through serious game play. *Comput. Assist. Lang. Learn.* **2022**, *37*, 27–60. [\[CrossRef\]](#)
86. Suh, D.; Kim, H.; Suh, E.E.; Kim, H. The Effect of Game-Based Clinical Nursing Skills Mobile Application on Nursing Students. *Comput. Inform. Nurs. CIN* **2022**, *40*, 769–778. [\[CrossRef\]](#)
87. Tang, Y.; Gu, R.; Zhao, Y.; Wang, J.; Zhang, Y.; Li, Q.; Wang, Z.; Wang, S.; Wei, Q.; Wei, L. Effectiveness of a Game-Based Mobile Application in Educating Nursing Students on Venous Blood Specimen Collection: A Randomized Controlled Trial. *Games Health J.* **2023**, *12*, 63–72. [\[CrossRef\]](#)
88. Verkuy, M.; Lapum, J.L.; St-Amant, O.; Hughes, M.; Romaniuk, D. Curricular uptake of virtual gaming simulation in nursing education. *Nurse Educ. Pract.* **2021**, *50*, 102967. [\[CrossRef\]](#)
89. Verkuy, M.; Lapum, J.L.; St-Amant, O.; Hughes, M.; Romaniuk, D.K.; McCulloch, T. Exploring Debriefing Combinations After a Virtual Simulation. *Clin. Simul. Nurs.* **2020**, *40*, 36–42. [\[CrossRef\]](#)
90. Volejnikova-Wenger, S.; Andersen, P.; Clarke, K.A. Student nurses' experience using a serious game to learn environmental hazard and safety assessment. *Nurse Educ. Today* **2021**, *98*, 104739. [\[CrossRef\]](#)
91. Wong, J.Y.; Ko, J.; Nam, S.; Kwok, T.; Lam, S.; Cheuk, J.; Chan, M.; Lam, V.; Wong, G.T.C.; Ng, Z.L.H.; et al. Virtual ER, a Serious Game for Interprofessional Education to Enhance Teamwork in Medical and Nursing Undergraduates: Development and Evaluation Study. *JMIR Serious Games* **2022**, *10*, e35269. [\[CrossRef\]](#)
92. Xie, Z.; Chen, F.; Zou, L.; Wang, F.; Yang, L. Using Virtual Reality in the Care of Older Adults with Dementia: A Randomized Controlled Trial. *J. Gerontol. Nurs.* **2023**, *49*, 25–32. [\[CrossRef\]](#)
93. Yang, C.L.; Chang, C.Y.; Jen, H.J. Facilitating undergraduate students' problem-solving and critical thinking competence via online escape room learning. *Nurse Educ. Pract.* **2023**, *73*, 103828. [\[CrossRef\]](#)
94. Wang, M.C.; Tang, J.S.; Liu, Y.P.; Chuang, C.C.; Shih, C.L. Innovative digital technology adapted in nursing education between Eastern and western countries: A mini-review. *Front. Public Health* **2023**, *11*, 1167752. [\[CrossRef\]](#) [\[PubMed\]](#)
95. Frenk, J.; Chen, L.C.; Chandran, L.; Groff, E.O.H.; King, R.; Meleis, A.; Fineberg, H.V. Challenges and opportunities for educating health professionals after the COVID-19 pandemic. *Lancet* **2022**, *400*, 1539–1556. [\[CrossRef\]](#) [\[PubMed\]](#)

96. Arif, Y.M.; Ayunda, N.; Diah, N.M.; Garcia, M.B. A Systematic Review of Serious Games for Health Education: Technology, Challenges, and Future Directions. In *Transformative Approaches to Patient Literacy and Healthcare Innovation*; Garcia, M., Almeida, R., Eds.; IGI Global Scientific Publishing: Hershey, PA, USA, 2024; pp. 20–45. [\[CrossRef\]](#)
97. Dicheva, N.K.; Rehman, I.U.; Anwar, A.; Nasralla, M.N.; Husamaldin, L.; Aleshaiker, S. Digital Transformation in Nursing Education: A Systematic Review on Computer-Aided Nursing Education Pedagogies, Recent Advancements and Outlook on the Post-COVID-19 Era. *IEEE Access* **2023**, *11*, 135659–135695. [\[CrossRef\]](#)
98. Tavares, N. The use and impact of game-based learning on the learning experience and knowledge retention of nursing undergraduate students: A systematic literature review. *Nurse Educ. Today* **2022**, *117*, 105484. [\[CrossRef\]](#) [\[PubMed\]](#)
99. Kuruca Ozdemir, E.; Dinc, L. Game-based learning in undergraduate nursing education: A systematic review of mixed-method studies. *Nurse Educ. Pract.* **2022**, *62*, 103375. [\[CrossRef\]](#)
100. Açı, A.; Keçeci, A. Effect of a simulation game on nursing students' reflective thinking skills: A mixed methods study. *BMC Nurs.* **2024**, *23*, 704. [\[CrossRef\]](#) [\[PubMed\]](#)
101. Vázquez-Calatayud, M.; García-García, R.; Regaira-Martínez, E.; Gómez-Urquiza, J. Real-world and game-based learning to enhance decision-making. *Nurse Educ. Today* **2024**, *140*, 106276. [\[CrossRef\]](#)
102. Sim, J.J.M.; Rusli, K.D.B.; Seah, B.; Levett-Jones, T.; Lau, Y.; Liaw, S.Y. Virtual Simulation to Enhance Clinical Reasoning in Nursing: A Systematic Review and Meta-analysis. *Clin. Simul. Nurs.* **2022**, *69*, 26–39. [\[CrossRef\]](#)
103. Bourgault, A.; Mayerson, E.; Nai, M.; Orsini-Garry, A.; Alexander, I.M. Implications of the COVID-19 pandemic: Virtual nursing education for delirium care. *Prof. Nurs. Off. J. Am. Assoc. Coll. Nurs.* **2022**, *38*, 54–64. [\[CrossRef\]](#)
104. García-Viola, A.; Garrido-Molina, J.M.; Márquez-Hernández, V.V.; Granados-Gámez, G.; Aguilera-Manrique, G.; Gutiérrez-Puertas, L. The Influence of Gamification on Decision Making in Nursing Students. *J. Nurs. Educ.* **2019**, *58*, 718–722. [\[CrossRef\]](#) [\[PubMed\]](#)
105. Sudarmilah, E.; Fadlilah, U.; Supriyono, H.; Irsyadi, F.Y.A.; Nugroho, Y.S.; Fatmawati, A. A review: Is there any benefit in serious games? *AIP Conf. Proc.* **2018**, *1977*, 020059. [\[CrossRef\]](#)
106. Koops, M.C.; Verheul, I.; Tiesma, R.; de Boer, C.W.; Koeweiden, R.T. Learning Differences Between 3D vs. 2D Entertainment and Educational Games. *Simul. Gaming* **2016**, *47*, 159–178. [\[CrossRef\]](#)
107. López Chávez, O.; Rodríguez, L.F.; Gutierrez-Garcia, J.O. A comparative case study of 2D, 3D and immersive-virtual-reality applications for healthcare education. *Int. J. Med. Inform.* **2020**, *141*, 104226. [\[CrossRef\]](#)
108. Min, A.; Min, H.; Kim, S. Effectiveness of serious games in nurse education: A systematic review. *Nurse Educ. Today* **2022**, *108*, 105178. [\[CrossRef\]](#)
109. Botha, B.S.; Wet, L.; Botma, Y. Undergraduate nursing student experiences in using immersive virtual reality to manage a patient with a foreign object in the right lung. *Clin. Simul. Nurs.* **2021**, *56*, 76–83. [\[CrossRef\]](#)
110. Zabaleta, J.; Blasco, A.; Esnal, T.; Aguinagalde, B.; López, I.J.; Fernandez-Monge, A.; Lizarbe, J.A.; Báez, J.; Aldazabal, J. Clinical trial on nurse training through virtual reality simulation of an operating room: Assessing satisfaction and outcomes. *Cir. Esp.* **2024**, *10*, 469–476. [\[CrossRef\]](#)
111. Wang, Y.; Hsu, Y.; Fang, K. The key elements of gamification in corporate training-The Delphi method. *Entertain. Comput.* **2021**, *40*, 100463. [\[CrossRef\]](#)
112. Majuri, J.; Koivisto, J.; Hamari, J. Gamification of education and learning: A review of empirical literature. In Proceedings of the 2nd International GamiFIN Conference GamiFIN 2018, Pori, Finland, 21–23 May 2018; CEUR-WS: Aachen, Germany, 2018; pp. 11–19.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.