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Review

Digital Educational Tools for Undergraduate Nursing Education: A Review of Serious Games, Gamified Applications and Non-Gamified Virtual Reality Simulations/Tools for Nursing Students

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Abstract: Educational technology has advanced tremendously in recent years, with several major developments becoming available in healthcare professionals' education, including nursing. Furthermore, the COVID-19 pandemic resulted in obligatory physical distancing, which forced an accelerated digital transformation of teaching tools. This review aimed to summarize all the available digital tools for nursing undergraduate education developed from 2019 to 2023. A robust search algorithm was implemented in the Scopus database, resulting in 1592 publications. Overall, 266 relevant studies were identified enrolling more than 22,500 undergraduate nursing students. Upon excluding multiple publications on the same digital tool, studies were categorized into three broad groups: serious games (28.0%), gamified applications (34.5%), and VR simulations and other non-gamified digital interventions (37.5%). Digital tools' learning activity type (categories = 8), geographical distribution (countries = 34), educational subjects (themes = 12), and inclusion within a curriculum course (n = 108), were also explored. Findings indicate that digital educational tools are an emerging field identified as a potential pedagogical strategy aiming to transform nursing education. This review highlights the latest advances in the field, providing useful insights that could inspire countries and universities which have not yet incorporated digital educational tools in their nursing curriculum, to invest in their implementation.

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

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1. Introduction

Undoubtedly, technological advances can transform any industry, including education. Educational technology has advanced tremendously over recent years with several major developments becoming available for healthcare professionals' education, including nursing [1]. To this end, serious games and gamification are perceived as an emerging field aiming to transform health professionals' education by improving knowledge, enhancing skills, and increasing satisfaction compared to traditional learning [2]. Furthermore, non-gamified virtual simulation experiences are increasingly used in academia, as they offer the perfect tool to enrich healthcare professionals' curriculum activities and practices [3].

Serious games, as defined by Alvarez, are "educational applications, 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 video games" [4]. On the other hand, gamification can be generally described

as using game design elements in non-game contexts [5] and is considered a practical educational approach that incorporates game elements and gameful experiences into the learning process [6]. Furthermore, virtual simulations are described as interactive learning processes where healthcare students can use screen-based platforms/software that portray realistic clinical events [7] in order to provide realistic work experiences [8].

Implementing game features and gamification in disciplines like science has proven to improve the teaching experience and boost student motivation, engagement, and learning outcomes [9]. Nevertheless, the flourishing of serious games and gamification in healthcare professionals' education is considered of higher importance, since it has the potential to provide students with unique opportunities to increase knowledge via active learning, enhance decision-making and clinical problem-solving skills, as well as to gain valuable experience by practicing their skills in risk-free environments [10]. Therefore, serious games and gamification have become an essential trend in contemporary healthcare professionals' education [11].

Assuredly, nursing education has followed this trend with several studies introducing serious digital games for developing nursing competencies [12], while game-based learning is also evolving into a vital strategy for complementing simulation scenarios in practical nursing courses [13]. To this end, a tenfold increase in gamified tools and interventions for healthcare education was observed a quinquennium before the COVID-19 healthcare crisis [11]. Furthermore, the COVID-19 pandemic resulted in obligatory physical distancing, which forced an accelerated digitalization in nursing schools' curricula [14] that is expected to have increased the number of relevant scientific publications exponentially.

The present review aimed to summarize all the studies reporting on digital tools available for undergraduate nursing education published during the past five years. Furthermore, this review highlights the most recent advances in the field, while providing useful development and implementation insights that could inspire universities or countries all around the globe that have not yet incorporated digital educational tools in their nursing curriculum, to invest in their development.

2. Materials and Methods

A literature review on the implementation of serious games, gamified applications and other non-gamified virtual simulations and digital interventions for undergraduate nursing students was conducted in the Scopus database. The research questions that guided this review included the following:

Question 1: How many digital tools have been developed and implemented in the past five years aiming to enhance undergraduate nursing education?
Question 2: Is the digitalization of nursing tools spread evenly around the world? Which countries are pioneers in utilizing digital tools for undergraduate nursing education?
Question 3: What type of digital nursing tools are implemented? Are certain types of tools more common than others?
Question 4: What are the most common nursing subjects introduced by those tools? What type of curriculum courses most often utilize digital tools to enhance nursing students' learning?

To form the search algorithm that would answer the above questions, we investigated common key terms used in relevant studies, as well as algorithms developed by previous similarly themed reviews. Keywords focused on two main categories: nursing education and game-based/digital learning. As a result, a robust and high-precision search algorithm was implemented in the Scopus database targeting thoroughly all the available literature and providing a vast number of studies related to the topic under research.

According to the above, the search algorithm developed for this review was: TITLE-ABS-KEY ((“nurs*” OR “nursing student*” OR “nursing”) 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 (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 (PUBYEAR, 2023) OR LIMIT-TO (PUBYEAR, 2022) OR LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2019)) AND (LIMIT-TO (LANGUAGE, "English"))

Among the inclusion criteria set were the following: studies published from January 2019 to December 2023, studies written in the English language, studies categorized as articles/reviews/conference papers/conference reviews/editorial doctype, studies involving only or mainly undergraduate nursing students as participants (among other healthcare students, nursing graduates or nursing master students and nursing faculty members) and studies developing and implementing digital tools with the purpose of being used in undergraduate nursing education.

The exclusion criteria included the following: studies implemented among other healthcare students, studies implemented among nurses or/and other healthcare professionals, studies including both nursing professionals and nursing students (not developed for undergraduate nursing education), studies including digital tools that are not developed for educational purposes (e.g., personal health of nursing students), studies reporting on the design/development of digital tools that have not yet been implemented for nursing students, and studies that we were not able to retrieve in full-text form.

A three-step review process was followed to screen the identified studies. First, the relevance of article titles was examined. Next, abstracts were screened to locate studies of interest. Lastly, the articles' full-text form was carefully reviewed to select the studies for inclusion. The methodological steps undertaken for conducting the review process are presented in Figure 1 (although this is not a systematic review, the flow diagram attempts to follow PRISMA guidelines for reporting systematic reviews) [15]. Overall, 1592 articles emerged from the search algorithm and upon a thorough review, 266 studies were finally included according to the inclusion and exclusion criteria. Table 1 summarizes the review process in numbers per stage according to the publication year of the studies. Sixteen studies were excluded because we were unable to retrieve their full-text (they are included in the "excluded from full-text" column in Table 1).

Table 1. Review process—number of excluded studies per stage and year—final sample.

Year of Publication	Total Number of Studies	Excluded from Title	Excluded from Abstract	Excluded from Full-Text	Included
2023	382	148	108	42	84
2022	377	173	94	42	68
2021	342	148	73	62	59
2020	283	119	90	37	37
2019	208	110	48	32	18
Total	1592	698	413	215	266

Data extraction of the included studies was performed utilizing an Excel file. All data were extracted by one author and confirmed by two other authors according to their expertise (one author verified nursing education-related data and another author confirmed digital tools-related information). Various pieces of information, including digital tool categories (serious games, gamified applications, non-gamified tools and virtual simulations), learning activity types (e.g., storytelling, role-playing games, quizzes, puzzles, simulations, etc.), country of implementation, year of publication, sample size, cycle of study of the enrolled nursing students (1st, 2nd, 3rd, 4th year), educational subject of the digital tools, nursing courses that implemented digital tools and other study design and intervention methodology related data, were extracted from the eligible studies.

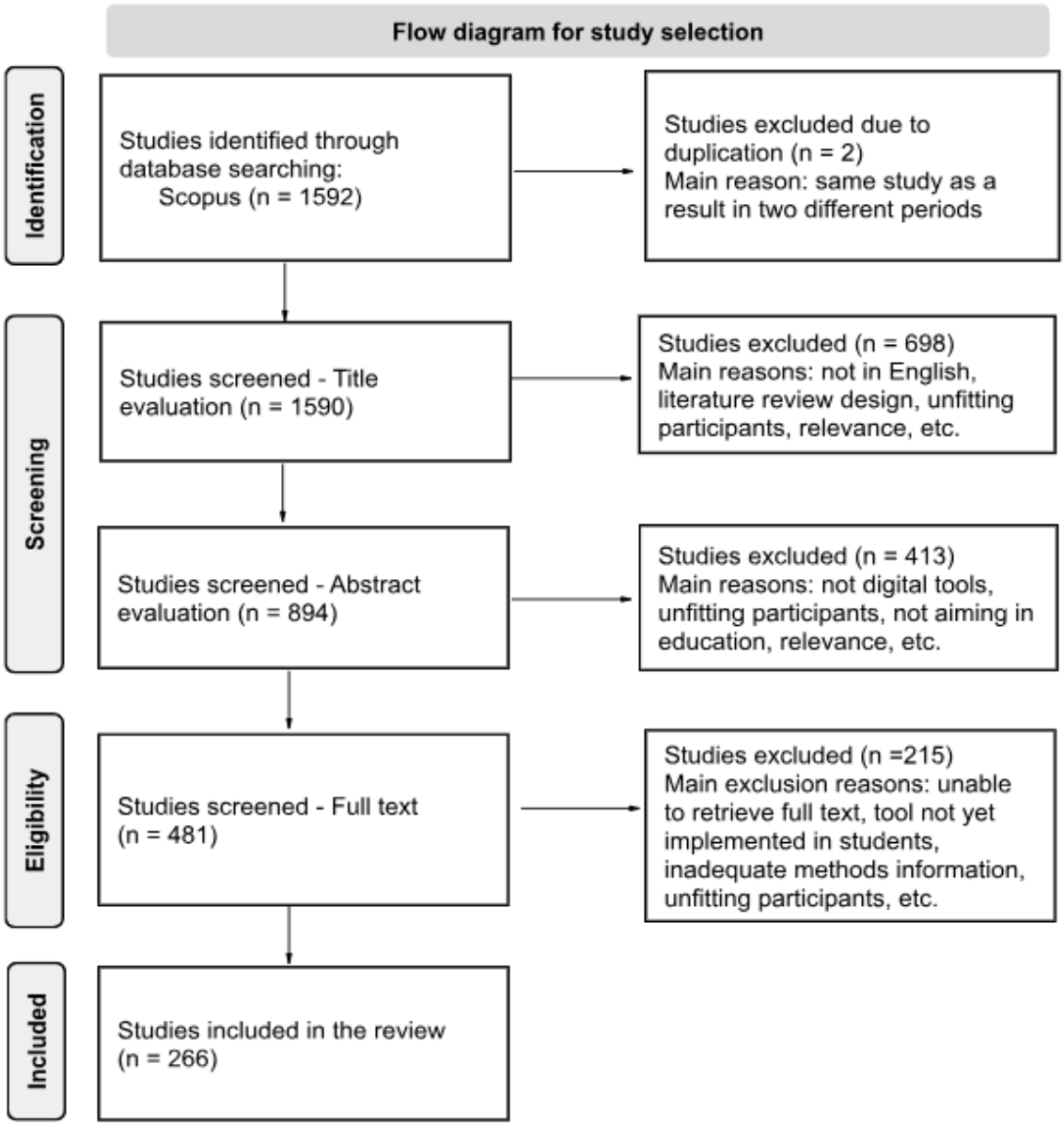

Figure 1. Study selection flow diagram.

3. Results

Overall, 266 studies satisfied the inclusion criteria and were included in the final review [16–281]. The main characteristics of the identified studies (first author name, title, short digital intervention description, and reference) are listed in Table 2. The majority of them were published in 2023 (n = 84), 2022 (n = 68) and 2021 (n = 59). A smaller number of studies was published in 2020 (n = 37) and 2019 (n = 18) (see Table 1).

Table 2. Summary table of studies included in the present review.

Author	Year	Title	Short Intervention Description [1]
Adhikari et al. [16]	2021	A mixed-methods feasibility study to assess the acceptability and applicability of immersive virtual reality sepsis game as an adjunct to nursing education	Immersive VR simulation
Akbari et al. [17]	2022	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	Virtual training serious game
Al-Mugheed et al. [18]	2022	Effectiveness of game-based virtual reality phone application and online education on knowledge, attitude and compliance of standard precautions among nursing students	Game-based VR mobile app
Aller et al. [19]	2023	Measuring Nursing Student Development Through Computer- Based Simulation Activities	Computer-based simulation activities
Aluthge et al. [20]	2022	Effectiveness of a VR-based Solution to Improve Practical Skills of Trainee Nurses in Sri Lanka	VR-based app
An et al. [21]	2022	Self-Regulated Learning Strategies for Nursing Students: A Pilot Randomized Controlled Trial.	AR mobile app
Anbro et al. [22]	2020	Using virtual simulations to assess situational awareness and communication in medical and nursing education: A technical feasibility study	VR simulation
Andreasen et al. [23]	2023	The effect of using desktop VR to practice preoperative handovers with the ISBAR approach: a randomized controlled trial	Desktop VR app
Anton-Solanas et al. [24]	2022	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	Digital escape room
Arias-Calderón et al. [25]	2022	Serious Games as a Method for Enhancing Learning Engagement: Student Perception on Online Higher Education During COVID-19	Serious game activities
Azher et al. [26]	2023	Virtual Simulation in Nursing Education: Headset Virtual Reality and Screen-based Virtual Simulation Offer A Comparable Experience	VR simulation
Banville et al. [27]	2023	Using Virtual Reality to Improve Nurses' Students' Clinical Surveillance in a Critical Care Context: A Psychological Perspective on Learning	Virtual Care Unit—immersive VR
Barner et al. [28]	2023	Exploring the impact of escape rooms on clinical judgment to improve patient outcomes: A quality improvement project	Virtual escape room
Bayram et al. [29]	2019	Effect of a game-based virtual reality phone application on tracheostomy care education for nursing students: A randomized controlled trial	Mobile game-based VR application
Berg et al. [30]	2020	Is individual practice in an immersive and interactive virtual reality application non-inferior to practicing with traditional equipment in learning systematic clinical observation? A randomized controlled trial.	Immersive VR app
Berg et al. [31]	2021	The effect of self-practicing systematic clinical observations in a multiplayer, immersive, interactive virtual reality application versus physical equipment: a randomized controlled trial.	Immersive VR app

Table 2. *Cont.*

Author	Year	Title	Short Intervention Description [1]
Blanié et al. [32]	2020	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.	Simulation with serious game
Bliss et al. [33]	2022	Projected Augmented Reality (P-AR) for Enhancing Nursing Education About Pressure Injury: A Pilot Evaluation Study	Projected AR system
Borges et al. [34]	2019	Evaluation of an educational technology using augmented reality for home visiting teaching	AR-based game activities
Botha et al. [35]	2021	Undergraduate Nursing Student Experiences in Using Immersive Virtual Reality to Manage a Patient With a Foreign Object in the Right Lung	Immersive VR simulation
Breitkreuz et al. [36]	2021	A multi-site study examining the usability of a virtual reality game designed to improve retention of sterile catheterization skills in nursing students	VR game
Brown et al. [37]	2023	Reimagining nursing education through virtual reality	VR simulation
Buijs-Spanjers et al. [38]	2020	The influence of a serious game's narrative on students' attitudes and learning experiences regarding delirium: an interview study	Video-based serious game
Burmester et al. [39]	2019	Interactive Computer Simulation for Adolescent Screening, Brief Intervention, and Referral to Treatment (SBIRT) for Substance Use in an Undergraduate Nursing Program	Virtual computer simulation
Cadet [40]	2023	Application of game-based online learning platform: Kahoot a formative evaluation tool to assess learning	Game-based online learning platform
Calik et al. [41]	2022	The effectiveness of serious games designed for infection prevention and promotion of safe behaviors of senior nursing students during the COVID-19 pandemic	Serious game
Calik et al. [42]	2022	The Effect of Serious Games for Nursing Students in Clinical Decision-Making Process: A Pilot Randomized Controlled Trial	Serious game
Campbell et al. [43]	2021	Increasing awareness, sensitivity, and empathy for Alzheimer's dementia patients using simulation	VR simulation
Capallera et al. [44]	2023	Training nurses in VR: exploring spatial mapping and free-hand interaction	Immersive VR simulation
Castro et al. [45]	2019	Impact of educational games on academic outcomes of students in the Degree in Nursing	Game-based learning tool
Cervi et al. [46]	2019	Project and Preliminary Evaluation of SimHosp, a Tool for Decision Making in Nursing	Computer simulation game
Chae et al. [47]	2023	An Immersive Virtual Reality Simulation for Cross-Cultural Communication Skills: Development and Feasibility	Immersive VR simulation
Chan et al. [48]	2021	Virtual reality teaching in chemotherapy administration: Randomised controlled trial	VR-based documents
Chang et al. [49]	2022	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	Role-playing game
Chang et al. [50]	2022	Effects of integrating maternity VR-based situated learning into professional training on students' learning performances	VR-based situated learning system

Table 2. *Cont.*

Author	Year	Title	Short Intervention Description [1]
Chang et al. [51]	2020	From experiencing to critical thinking: a contextual game-based learning approach to improving nursing students' performance in Electrocardiogram training	Role-playing game
Chang et al. [52]	2022	The effect of a virtual simulation-based educational application on nursing students' belief and self-efficacy in communicating with patients about complementary and alternative medicine	Virtual simulation smartphone app
Chang et al. [53]	2021	The effects of a virtual simulation-based, mobile technology application on nursing students' learning achievement and cognitive load: Randomized controlled trial	Virtual simulation based mobile app
Chang et al. [54]	2021	Exploring the experiences of nursing students in using immersive virtual reality to learn nursing skills	Immersive VR simulation
Chao et al. [55]	2021	The effects of an immersive 3d interactive video program on improving student nurses' nursing skill competence: A randomized controlled trial study	Immersive 3D video-program
Chen et al. [56]	2022	Development and Application of AR-Based Assessment System for Infant Airway Obstruction First Aid Training	AR simulation
Chen et al. [57]	2023	The effects of an augmented reality application developed for paediatric first aid training on the knowledge and skill levels of nursing students: An experimental controlled study	AR simulation
Chevalier et al. [58]	2023	Impact of virtual reality on performance among undergraduate healthcare professionals: A cross-sectional study.	VR simulation
Chircop et al. [59]	2020	Gett'n on the bus: evaluation of Sentinel City®3.0 virtual simulation in community/population health clinical placement	VR simulation
Choi et al. [60]	2020	Efficacy of the Computer Simulation-Based, Interactive Communication Education Program for Nursing Students	Computer-based simulation
Choi [61]	2021	Development of a Computer Simulation-based, Interactive, Communication Education Program for Nursing Students	Computer-based simulation
Choi [62]	2022	Virtual reality simulation for learning wound dressing: Acceptance and usability	VR simulation
Chow et al. [63]	2022	Factors affecting nursing students' intention to use a 3D game to learn field triage skills: a structural equation modelling analysis	3D game-based virtual world
Chun et al. [64]	2021	Exploration of Visuo-haptic Interactions to Support Learning Leopold's Maneuvers Process in Virtual Reality	VR simulation
Cieslowski et al. [65]	2023	The Development and Pilot Testing of Immersive Virtual Reality Simulation Training for Prelicensure Nursing Students: A QuasiExperimental Study	Immersive VR simulation
Collier et al. [66]	2023	The Development and Feasibility of an Empathy Virtual Reality Scenario in Healthcare Education	Immersive VR simulation
Coveney et al. [67]	2022	First year nursing students' evaluation of Kahoot! to facilitate learning and testing knowledge. A pilot study in Ireland and Italy	Game-based learning platform
Craig et al. [68]	2023	Evaluation of a dementia awareness game for undergraduate nursing students in Northern Ireland: a Pre-/Post-Test study	Serious game

Table 2. *Cont.*

Author	Year	Title	Short Intervention Description [1]
da Silva et al. [69]	2019	Satisfaction Analysis for Using Educational Serious Games for Teaching Wound Treatment	Serious game
Dang et al. [70]	2020	Comparing Virtual Reality Telepresence and Traditional Simulation Methods: A Pilot Study	VR telepresence
de Beer et al. [71]	2023	Perceived contribution of a hybrid serious game to the development of collaborative problem solving among undergraduate nursing students: A mixed method design	Hybrid serious game
Díaz et al. [72]	2021	Comparison of Clinical Options: High-Fidelity Manikin-Based and Virtual Simulation	Virtual simulation
Donnelly et al. [73]	2023	Preparing students for clinical placement using 360-video	Immersive VR 360-video
Dubovi et al. [74]	2022	Cognitive and emotional engagement while learning with VR: The perspective of multimodal methodology	VR-based simulation
Dubovi et al. [75]	2023	Learning with virtual reality simulations: direct versus vicarious instructional experience	VR simulation
Dubovi et al. [76]	2023	Playing the Role of a Nurse in a Virtual Reality Simulation: A Safe Environment for Emotion Management.	Low-immersive VR simulation
Egilsdottir et al. [77]	2021	Configuration of Mobile Learning Tools to Support Basic Physical Assessment in Nursing Education: Longitudinal Participatory Design Approach	Digital simulation program
EL Machtani EL Idrissi et al. [78]	2022	The Impact of Serious Game on the Nursing Students' Learning, Behavioral Engagement, and Motivation	Serious game
Elzekyet al [79]	2022	Effect of gamified flipped classroom on improving nursing students' skills competency and learning motivation: a randomized controlled trial	Gamified flipped classroom
Erdoğan et al. [80]	2023	Evaluation of the Effectiveness of Digital Game-Based Learning Given to Nursing Students for the Developmental Care of Infants in Neonatal Intensive Care Unit	Digital game
Fairén et al. [81]	2020	VR4Health: Personalized teaching and learning anatomy using VR	Serious game
Farsi et al. [82]	2021	Comparative Effectiveness of Simulation versus Serious Game for Training Nursing Students in Cardiopulmonary Resuscitation: A Randomized Control Trial	Serious game on smartphone platform
Flo et al. [83]	2021	Nursing students' experiences of virtual simulation when using a video conferencing system—a mixed methods study	Virtual simulation
Fontenot et al. [84]	2023	Examining the Perceptions Among Undergraduate Nursing Students Using Virtual Reality in a Community Course: A Mixed-Methods Explanatory Study	Immersive VR simulation
García-Pazo et al. [85]	2023	Virtual reality and critical care education in nursing: A cross-sectional study	Immersive VR simulation
García-Viola et al. [86]	2019	The Influence of Gamification on Decision Making in Nursing Students	Gamified app
Gazzelloni et al. [87]	2023	360-Degree Video for Cardiopulmonary Resuscitation (CPR) Knowledge: Preliminary Data of a Randomized Controlled Trial	Immersive 360-degree video simulation
Georg et al. [88]	2019	Psychometric properties of the virtual patient version of the Lasater Clinical Judgment Rubric	Virtual patient simulations
Gilardi et al. [89]	2022	Nursing XR—a VR application to teach decision making to student nurses	VR app

Table 2. *Cont.*

Author	Year	Title	Short Intervention Description [1]
Giordano et al. [90]	2023	Opioid-involved overdose trainings delivered using remote learning modalities	VR immersive video
Giordano et al. [91]	2020	A pilot study to compare virtual reality to hybrid simulation for opioid-related overdose and naloxone training	VR simulation-360
Girão et al. [92]	2023	NurseVR: Development of a Serious Virtual Reality Game for Medication Preparation and Administration Training	VR serious game
Goldsworthy et al. [93]	2022	The impact of virtual simulation on the recognition and response to the rapidly deteriorating patient among undergraduate nursing students	Virtual simulation
Gonzalez et al. [94]	2020	Neurological Assessment Using a Physical-Virtual Patient (PVP)	Physical-virtual patient using AR
Grech et al. [95]	2021	Nursing students' evaluation of a gamified public health educational webinar: A comparative pilot study	Gamified webinar
Gu et al. [96]	2022	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	Game-based mobile app
Gutiérrez-Puertas et al. [97]	2021	Guess it (SVUAL): An app designed to help nursing students acquire and retain knowledge about basic and advanced life support techniques	Mobile app game
Hall [98]	2023	Integrating Immersive Virtual Reality Simulation in Prelicensure Nursing Education	Immersive VR app
Han et al. [99]	2021	Exploring the experience of nursing undergraduates in using gamification teaching mode based on the flow theory in nursing research: A qualitative study	Gamification teaching model
Hannans [100]	2023	Integrating LGBTQI+ Content in Nursing Education Using Immersive Virtual Reality: Embodying Eden	Immersive VR simulation
Hannans et al. [101]	2021	See it, hear it, feel it: embodying a patient experience through immersive virtual reality	Immersive VR simulation
Hanson et al. [102]	2019	Effectiveness of three-dimensional visualisation on undergraduate nursing and midwifery students' knowledge and achievement in pharmacology: A mixed methods study	Immersive 3D visualisation
Hanson et al. [103]	2020	The effects of a virtual learning environment compared with an individual handheld device on pharmacology knowledge acquisition, satisfaction and comfort ratings	Three-dimensional immersion simulation
Hara et al. [104]	2021	Design and evaluation of a 3D serious game for communication learning in nursing education	Serious game in 3D immersive VR
Hardie et al. [105]	2020	Nursing & Midwifery students' experience of immersive virtual reality storytelling: an evaluative study	Immersive VR storytelling
Havola et al. [106]	2021	The Effects of Computer-Based Simulation Game and Virtual Reality Simulation in Nursing Students' Self-evaluated Clinical Reasoning Skills	A computer-based simulation game and a VR simulation
Helle et al. [107]	2023	Health Care and Social Work Students' Experiences With a Virtual Reality Simulation Learning Activity: Qualitative Study	VR simulation 360° videos
Herbert et al. [108]	2021	Developing a Smartphone App With Augmented Reality to Support Virtual Learning of Nursing Students on Heart Failure	Smartphone AR app
Hester et al. [109]	2021	Using an educational mobile application to teach students to take vital signs	Mobile app using instructional videos

Table 2. *Cont.*

Author	Year	Title	Short Intervention Description [1]
Ho et al. [110]	2021	The effectiveness of the iLearning application on chest tube care education in nursing students	Gamified mobile app
Hoffman et al. [111]	2021	Using Virtual Simulation to Teach Community Health Nursing Students About Public Health Nursing	Virtual simulation
Hu et al. [112]	2022	Teaching Disaster Evacuation Management Education to Nursing Students Using Virtual Reality Mobile Game-Based Learning	VR mobile game-based app
Hu et al. [113]	2022	Improving Nursing Students' COVID-19 Knowledge Using a Serious Game	Serious game-based computer app
Hwang et al. [114]	2023	Facilitating decision-making performances in nursing treatments: a contextual digital game-based flipped learning approach	Game-based flipped learning approach
Ignacio et al. [115]	2020	The use of web-based classroom gaming to facilitate cognitive integration in undergraduate nursing students: A mixed methods study	Gamified web-based platform
Inangil et al. [116]	2022	Effectiveness of the Use of Animation and Gamification in Online Distance Education During Pandemic	Gamified online platform
Irwin et al. [117]	2019	Looking Good Sister! The Use of a Virtual World to Develop Nursing Skills	Three-dimensional VR simulation
İsmailoğlu et al. [118]	2020	Comparison of the effectiveness of the virtual simulator and video-assisted teaching on intravenous catheter insertion skills and self-confidence: A quasi-experimental study	VR simulation
Jeong et al. [119]	2022	Development and evaluation of virtual reality simulation education based on coronavirus disease 2019 scenario for nursing students: A pilot study.	VR simulation
Johnsen et al. [120]	2021	Nursing students' perceptions of combining hands-on simulation with simulated patients and a serious game in preparing for clinical placement in home healthcare: A qualitative study	Video-based serious game
Jung et al. [121]	2022	The Effectiveness of Learning to Use HMD-Based VR Technologies on Nursing Students: Chemoport Insertion Surgery	VR simulation
Kang et al. [122]	2020	Comparison of Learning Effects of Virtual Reality Simulation on Nursing Students Caring for Children with Asthma	VR simulation
Kardong-Edgren et al. [123]	2019	Evaluating the Usability of a Second-Generation Virtual Reality Game for Refreshing Sterile Urinary Catheterization Skills	VR game
Kayyali et al. [124]	2021	Development and evaluation of a serious game to support learning among pharmacy and nursing students	Serious game web app
Keys et al. [125]	2021	The integration of virtual simulation gaming into undergraduate nursing resuscitation education: A pilot randomised controlled trial	Virtual simulation game
Khraisat et al. [126]	2020	How to teach intramuscular injection through virtual learning environment in COVID-19 pandemic time for nursing students	Three-dimensional virtual simulation
Kiegaldie et al. [127]	2023	Virtual reality simulation for nursing education: effectiveness and feasibility	VR simulation

Table 2. *Cont.*

Author	Year	Title	Short Intervention Description [1]
Killam et al. [128]	2021	Virtual Simulations to Replace Clinical Hours in a Family Assessment Course: Development Using H5P, Gamification, and Student Co-Creation	Virtual simulation games
Killam et al. [129]	2021	Motivation and Engagement of Nursing Students in 2 Gamified Courses: A Mixed-Methods Study	Gamified course activities
Kim et al. [130]	2022	Effects of Situation-Based Flipped Learning and Gamification as Combined Methodologies in Psychiatric Nursing Education: A Quasi-Experimental Study	Gamified flipped learning
Kim et al. [131]	2022	Effects of a Patient Experience-Based Virtual Reality Blended Learning Program on Nursing Students	VR simulation
Kim et al. [132]	2021	Virtual Experience of Perioperative Patients: Walking in the Patients' Shoes Using Virtual Reality and Blended Learning	VR simulation
Kim et al. [133]	2023	Constructing a Mixed Simulation With 360° Virtual Reality and a High-Fidelity Simulator: Usability and Feasibility Assessment	360° VR simulation
Kim et al. [134]	2021	Adaptation of Extended Reality Smart Glasses for Core Nursing Skill Training Among Undergraduate Nursing Students: Usability and Feasibility Study	AR-XR smart glass app
Kirkman et al. [135]	2022	Enriching Nursing Simulation With a Threefold Hybrid Approach	hybrid simulation in a gaming platform
Koivisto et al. [136]	2023	Nursing Students' Scenario Performance: Game Metrics in a Simulation Game	Three-dimensional computer simulation game
Kor et al. [137]	2022	Exploring nursing students' learning experiences and attitudes toward older persons in a gerontological nursing course using self-regulated online enquiry-based learning during the COVID-19 pandemic: A mixed-methods study	Gamified online platform
Kurt et al. [138]	2021	The effect of mobile augmented reality application developed for injections on the knowledge and skill levels of nursing students: An experimental controlled study	Mobile AR games
Lau et al. [139]	2023	Mid-career switch nursing students' perceptions and experiences of using immersive virtual reality for clinical skills learning: A mixed methods study	Immersive VR simulation
Lau et al. [140]	2023	Design and Evaluation of Using Head-Mounted Virtual Reality for Learning Clinical Procedures: Mixed Methods Study	Immersive VR simulation
Lee et al. [141]	2023	Development and Effects of a Virtual Reality Simulation Nursing Education Program Combined With Clinical Practice Based on an Information Processing Model	Web-based VR simulation
Lee et al. [142]	2023	Effectiveness of the Patient's Severity Classification Competency Promotion Virtual Reality Program of Nursing Students during the COVID-19 Pandemic Period	VR-based simulation
Lee et al. [143]	2023	Improving Active Collaborative Clinical Learning Through a Mobile Application for Undergraduate Nursing Students	Gamified mobile app
Lee et al. [144]	2022	Development and evaluation of a virtual reality mechanical ventilation education program for nursing students	VR simulation
Lee et al. [145]	2023	Exploring the potential use of the metaverse in nurse education through a mock trial	Metaverse platform-virtual world
Lee et al. [146]	2023	Virtual reality simulation-enhanced blood transfusion education for undergraduate nursing students: A randomised controlled trial	VR simulation

Table 2. *Cont.*

Author	Year	Title	Short Intervention Description [1]
Lee [147]	2022	Implementation and Evaluation of a Virtual Reality Simulation: Intravenous Injection Training System	VR simulation
Lee et al. [148]	2023	Evaluation of a Virtual Reality Simulation to Improve Problem-Based Learning for Neurologic Examination in Nursing Students	VR Simulation
Lee et al. [149]	2021	Nursing Students' Experiences with Computer Simulation-Based Communication Education	Computer-based simulation
Lee et al. [150]	2020	Usability of mental illness simulation involving scenarios with patients with schizophrenia via immersive virtual reality: A mixed methods study	VR simulation using 360-degree videos
Lee et al. [151]	2023	Effect of Virtual Reality Based Nursing Skills on the Performance Ability, Performance Confidence, and Practice Satisfaction of Nursing College Students	VR practice
Li et al. [152]	2023	Implementation and Evaluation of a Virtual Reality-Based Cognitive Assessment and Rehabilitation Simulation Course in Undergraduate Nursing Students: A Pre-Post Study	VR simulation
Liang et al. [153]	2021	Enhancing stroke assessment simulation experience in clinical training using augmented reality	MR app
Liaw et al. [154]	2020	Nurse-Physician Communication Team Training in Virtual Reality Versus Live Simulations: Randomized Controlled Trial on Team Communication and Teamwork Attitudes	Computer-based VR simulation
Liaw et al. [155]	2022	Translation of an evidence-based virtual reality simulation-based interprofessional education into health education curriculums: An implementation science method	VR simulation
Liaw et al. [156]	2019	Design and evaluation of a 3D virtual environment for collaborative learning in interprofessional team care delivery	3D virtual simulation
Liaw et al. [157]	2023	Desktop Virtual Reality Versus Face-to-Face Simulation for Team-Training on Stress Levels and Performance in Clinical Deterioration: a Randomised Controlled Trial	Desktop VR simulation
Liaw et al. [158]	2023	Artificial Intelligence Versus Human-Controlled Doctor in Virtual Reality Simulation for Sepsis Team Training: Randomized Controlled Study	AI VR simulation
Liaw et al. [159]	2023	Artificial intelligence in virtual reality simulation for interprofessional communication training: Mixed method study	AI VR simulation
Liaw et al. [160]	2020	Virtual Reality Simulation in Interprofessional Round Training for Health Care Students: A Qualitative Evaluation Study	VR simulation
Lima et al. [161]	2022	A Serious Game (Immunitates) About Immunization: Development and Validation Study	Mobile serious game
Liu [162]	2021	Virtual Simulation in Undergraduate Nursing Education: Effects on Students' Correct Recognition of and Causative Beliefs About Mental Disorders	Virtual simulation
Liu et al. [163]	2021	Where's the germs? The effects of using virtual reality on nursing students' hospital infection prevention during the COVID-19 pandemic	VR activity in web-based platform
Lo et al. [164]	2022	Effectiveness of immersive virtual reality training in nasogastric tube feeding education: A randomized controlled trial	Immersive VR simulation

Table 2. *Cont.*

Author	Year	Title	Short Intervention Description [1]
Luctkar-Flude et al. [165]	2022	Impact of Virtual Simulation Games to Promote Cultural Humility Regarding the Care of Sexual and Gender Diverse Persons: A Multi-Site Pilot Study	Virtual simulation screen-based games
Ma et al. [166]	2021	Feasibility of a Computer Role-Playing Game to Promote Empathy in Nursing Students: The Role of Immersiveness and Perspective	Computer role-playing game
Mackavey et al. [167]	2019	Innovative strategies: Increased engagement and synthesis in online advanced practice nursing education	Gamified presentations
Mahaffey [168]	2021	"N.A.M.E." FUN! Emojis may illustrate structure-function relationships of neurotransmitters to health professions students	Virtual game
Maheu-Cadotte et al. [169]	2023	Development and Contribution of a Serious Game to Improve Nursing Students' Clinical Reasoning in Acute Heart Failure: A Multimethod Study	Serious game
Mäkinen et al. [170]	2023	Graduating nursing students' user experiences of the immersive virtual reality simulation in learning—A qualitative descriptive study	Immersive VR simulation game
Masoumian Hosseini et al. [171]	2023	Crossover design in triage education: the effectiveness of simulated interactive vs. routine training on student nurses' performance in a disaster situation	Simulation game
Masoumian Hosseini et al. [172]	2022	Game-based vs. Case-based Training for Increasing Knowledge and Behavioral Fluency of Nurse Students Regarding Crisis and Disaster Management; a Quasi-Experimental Study	Serious game
Matias et al. [173]	2023	Semio em Jogo®: development and evaluation of a playful-educational technology for nursing education	Serious game
Matsuura et al. [174]	2021	Development of a VR/HMD System for Simulating Several Scenarios of Post-Operative Delirium.	VR simulation
Matsuura et al. [175]	2021	Changes in The Perception of Postoperative Delirium Before and After a Simulated Experience of Postoperative Delirium in Nursing Students	VR simulation
Mayor Silva et al. [176]	2023	Development of Communication Skills Through Virtual Reality on Nursing School Students: Clinical Trial.	VR simulation
Mei Hua Kerryet al [177]	2023	The Application of Aged Simulation and Virtual Reality in Gerontological Nursing Education	VR simulation
Menon et al. [178]	2022	Augmented Reality in Nursing Education—A Pilot Study	AR simulation
Mirzaei et al. [179]	2021	Gamification in Cardiovascular Pharmacology Course as Real Work Simulation by Case on Medical Sciences	Serious game
Nakazawa et al. [180]	2023	Augmented reality-based affective training for improving care communication skill and empathy	AR training system
Nasiri et al. [181]	2021	Playing with Surgical Instruments (PlaSurIn)" game to train operating room novices how to set up basic surgical instruments: A validation study	Serious game
Navarro-Martínez et al. [182]	2023	Performance of Nursing Students with a Graphic Novel and a Collaborative Quiz Competition: A Quasi-Experimental Study	Gamified online teaching platform
Negreiros et al. [183]	2022	E-MunDiabetes: A Mobile Application for Nursing Students on Diabetes Education During the COVID-19 Pandemic	Gamified mobile app

Table 2. *Cont.*

Author	Year	Title	Short Intervention Description [1]
Negreiros et al. [184]	2022	Effect of an app on students' knowledge about diabetes during the COVID-19 pandemic	Gamified mobile app
Neuhöfer et al. [185]	2021	Evolution of an Approach for Digital Learning and Training in Nursing	Gamified learning module
Ng et al. [186]	2020	Using immersive reality in training nursing students	Immersive VR and AR simulations
Novoseltseva et al. [187]	2022	Examining Students' Behavior in a Digital Simulation Game for Nurse Training	Simulation game
Novoseltseva et al. [188]	2020	Factors Affecting Success in a Digital Simulation Game for Nurse Training	Simulation game
Nugraha et al. [189]	2023	Development of Virtual Reality Head-Mounted Display: Teaching Infection Prevention and Control to Millennial Nursing Students	Immersive VR simulation
Nurse-Clarke et al. [190]	2023	An Investigation of the Effects of Virtual Gaming Simulation With Enhanced Gaming Elements: A Pilot Study	Virtual gaming simulation
Oh et al. [191]	2023	Effectiveness of a virtual reality application-based education programme on patient safety management for nursing students: A pre-test-post-test study	VR smartphone app
Ordu et al. [192]	2023	The effect of virtual game simulation on students' perception of nursing diagnosis and clinical practice: Post-test only randomized controlled trial	Virtual game simulation
Ordu et al. [193]	2023	The effects of virtual gaming simulation on nursing students' diagnosis, goal setting, and diagnosis prioritization: A randomized controlled trial	Virtual game simulation
Pardue et al. [194]	2023	Exploring the Development of Nursing Clinical Judgment Among Students Using Virtual Reality Simulation	Immersive VR simulation
Park et al. [195]	2023	Using virtual reality to teach nursing students communication skills when breaking bad news: A focus group exploration of participant experiences	VR immersive 360-video
Park et al. [196]	2022	Learning effects of virtual versus high-fidelity simulations in nursing students: a crossover comparison	Virtual simulation
Park et al. [197]	2023	Effect of Virtual-Reality Simulation of Indwelling Catheterization on Nursing Students' Skills, Confidence, and Satisfaction	Three-dimensional VR simulation
Park et al. [198]	2023	Development of a virtual reality program in South Korea for the measurement of vital signs in children: a methodological study	VR program
Penalo et al. [199]	2023	Effects of the Virtual Simulation Prebriefing-Debriefing Educational Strategy on Nursing Students' Self-Efficacy and Virtual Simulation Performance: A Quasi-Experimental Study	VR simulation
Plotzky et al. [200]	2023	My hands are running away—learning a complex nursing skill via virtual reality simulation: a randomised mixed methods study.	Immersive VR simulation
Pons Lelardeux et al. [201]	2020	A Method to Balance Educational Game Content and Lesson Duration: The Case of a Digital Simulation Game for Nurse Training	Game-based simulation
Puah et al. [202]	2022	Mobile device: a useful tool to teach inhaler devices to healthcare professionals	Gamified mobile app

Table 2. *Cont.*

Author	Year	Title	Short Intervention Description [1]
Quay et al. [203]	2023	Innovative Use of Virtual Reality to Facilitate Empathy Toward Older Adults in Nursing Education	Immersive VR video
Quqandi et al. [204]	2019	Mobile Augmented Reality in Nursing Educational Environments	Mobile AR app
Rodríguez-Abad et al. [205]	2023	Online (versus face-to-face) augmented reality experience on nursing students' leg ulcer competency: Two quasi-experimental studies	AR-based platform
Rodríguez-Abad et al. [206]	2022	Effectiveness of augmented reality in learning about leg ulcer care: A quasi-experimental study in nursing students	AR-based platform
Rodriguez-Ferrer et al. [207]	2022	A Web-Based Escape Room to Raise Awareness About Severe Mental Illness Among University Students: Randomized Controlled Trial	Web-based escape room
Rodriguez-Ferrer et al. [208]	2022	The use of digital escape rooms in nursing education	Digital escape room
Rodriguez et al. [209]	2023	Assessment of preclinical learning using virtual reality based education for nursing students	VR app
Roman et al. [210]	2022	A serious game for online-based objective structured clinical examination in nursing: A qualitative study	Serious game
Ropero-Padilla et al. [211]	2021	A gameful blended-learning experience in nursing: A qualitative focus group study	Gamified platform
Rosa-Castillo et al. [212]	2022	Gamification on Instagram: Nursing students' degree of satisfaction with and perception of learning in an educational game	Instagram-based game
Rosa-Castillo et al. [213]	2023	The effectiveness of an Instagram-based educational game in a Bachelor of Nursing course: An experimental study	Instagram-based game
Roseet al [214]	2020	Testing a Web-Based Intervention to Improve Awareness of Civility and Incivility in Baccalaureate Nursing Students	VR simulation
Rosillo et al. [215]	2021	Escape Room Dual Mode Approach to Teach Maths during the COVID-19 Era	Digital escape room
Rossler et al. [216]	2019	Acquisition of Fire Safety Knowledge and Skills With Virtual Reality Simulation	VR simulation
Rumsey et al. [217]	2023	Evolving Approaches to Meet Clinical Hours for Undergraduate Nursing Students during COVID-19	Virtual simulation
Rushton et al. [218]	2020	The Use of Immersive and Virtual Reality Technologies to Enable Nursing Students to Experience Scenario-Based, Basic Life Support Training-Exploring the Impact on Confidence and Skills	Immersive VR simulation
Saab et al. [219]	2022	Nursing students' views of using virtual reality in healthcare: A qualitative study	VR-based serious game
Saab et al. [220]	2023	Virtual Reality Simulation in Nursing and Midwifery Education: A Usability Study	VR simulation
Sáiz-Manzanares et al. [221]	2021	Usefulness of Digital Game-Based Learning in Nursing and Occupational Therapy Degrees: A Comparative Study at the University of Burgos	Gamified activities
Salem et al. [222]	2023	The effectiveness of computer-based simulation on nursing students' electrocardiogram interpretation	Computer-based simulation

Table 2. *Cont.*

Author	Year	Title	Short Intervention Description [1]
Samosorn et al. [223]	2022	Teaching airway insertion skills to nursing faculty and students using virtual reality: A pilot stud	VR simulation
San Martín-Rodríguez et al. [224]	2020	A themed game to learn about nursing theories and models: A descriptive study	Serious game with AR
Sarvan et al. [225]	2022	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	Serious game simulation
Seiler et al. [226]	2022	VR in nursing education: high-fidelity vs. low-fidelity implementations	VR simulation
Seo et al. [227]	2021	Work-in-Progress–Design and Evaluation of 360 VR Immersive Interactions in Nursing Education	Immersive 360 VR app
Seok-Young [228]	2023	The Effects of Blended Learning Using Virtual Reality Simulation in Pediatrics-adolescent Nursing Clinical Practice	VR simulation
Seok et al. [229]	2022	Development of a Health Promotion Application on Cancer Survivorship as an Educational Content for Nursing Students	Gamified mobile app
Shah et al. [230]	2022	Undergraduate Nursing Students' Experiences and Perceptions of Self-Efficacy in Virtual Reality Simulation	VR Simulation Learning System
Shah et al. [231]	2022	Simulation learning system with virtual reality for supporting practice readiness in undergraduate nursing education	VR Simulation Learning System
Shah et al. [232]	2021	Modeling Educator Use of Virtual Reality Simulations in Nursing Education Using Epistemic Network Analysis	VR Simulation Learning System
Shah et al. [233]	2022	Quality and Safety Education for Nursing (QSEN) in Virtual Reality Simulations: A Quantitative Ethnographic Examination	VR Simulation Learning System
Shahmoradi et al. [234]	2021	Training pain management to nursing students: Designing, implementing, and evaluating a mobile-based application	Gamified mobile-based app
Shorey et al. [235]	2020	Communication skills training using virtual reality: A descriptive qualitative study	Virtual app using AI
Shujuan et al. [236]	2022	The Use of Virtual Reality to Improve Disaster Preparedness Among Nursing Students: A Randomized Study	VR simulation
Siah et al. [237]	2022	Evaluation of nursing students' efficacy, attitude, and confidence level in a perioperative setting using virtual-reality simulation	VR simulation
Singleton et al. [238]	2021	Deteriorating Patient Training Using Nonimmersive Virtual Reality: A Descriptive Qualitative Study	VR simulation
Singleton et al. [239]	2022	Effect of non-immersive virtual reality simulation on type 2 diabetes education for nursing students: a randomised controlled trial	VR simulation
Smith et al. [240]	2021	Evaluation of two simulation methods for teaching a disaster skill	VR simulation
Smith et al. [241]	2020	Enhancing discipline specific skills using a virtual environment built with gaming technology	VR simulation
Son et al. [242]	2023	Nursing Students' Experience of Using HoloPatient During the Coronavirus Disease 2019 Pandemic: A Qualitative Descriptive Study	MR simulation

Table 2. *Cont.*

Author	Year	Title	Short Intervention Description [1]
Soojeong et al. [243]	2020	Learning by Doing: Evaluation of an Educational VR Application for the Care of Schizophrenic Patients	VR platform—360
Sook et al. [244]	2023	Development and Evaluation of Virtual Reality-based Simulation Content for Nursing Students Regarding Emergency Triage	VR-based simulation
Soyoof et al. [245]	2022	A mixed-methods study of the incidental acquisition of foreign language vocabulary and healthcare knowledge through serious game play	Serious game
Stuart et al. [246]	2021	Building a Handoff Communication Virtual Experience for Nursing Students Using Virtual Humans	Virtual simulation
Stuart et al. [247]	2023	Using augmented reality filters to display time-based visual cues	AR image filters
Su et al. [248]	2023	Effects of a virtual simulation-based interprofessional education activity for rehabilitation nursing using shared resources: A quasi-experimental study	Virtual simulation
Suh et al. [249]	2020	The Effect of Game-Based Clinical Nursing Skills Mobile Application on Nursing Students	Game-based mobile app
Taçgın [250]	2020	Immersive virtual reality as an action: measuring approach and learning status of learners after planning myVOR	Immersive VR environment
Taçgın [251]	2020	The perceived effectiveness regarding Immersive Virtual Reality learning environments changes by the prior knowledge of learners	Immersive VR environment
Tang et al. [252]	2023	Effectiveness of a Game-Based Mobile Application in Educating Nursing Students on Venous Blood Specimen Collection: A Randomized Controlled Trial	Game-based mobile app
Thompson et al. [253]	2020	Nursing students' engagement and experiences with virtual reality in an undergraduate bioscience course	VR environment
Tinôco et al. [254]	2021	Effect of educational intervention on clinical reasoning skills in nursing: A quasi-experimental study	Virtual simulation—mobile app
Tran et al. [255]	2020	A virtual patient model for students' interprofessional learning in primary healthcare	Virtual patient model
Tsai et al. [256]	2021	Work-in-Progress-Development of Immersive Nursing Skills Learning System and Evaluation of Learning Effectiveness	Immersive 360 VR video
Vanduhe et al. [257]	2019	Students' Evidential Increase in Learning Using Gamified Learning Environment	Gamified learning platform
Verkuyl et al. [258]	2019	Nursing Students' Perceptions Using an Interactive Digital Simulation Table: A Usability Study.	Digital simulation table
Verkuyl et al. [259]	2021	Curricular uptake of virtual gaming simulation in nursing education	Virtual simulation games
Verkuyl et al. [260]	2020	Exploring Debriefing Combinations After a Virtual Simulation	Virtual simulation games
Volejnikova-Wenger et al. [261]	2021	Student nurses' experience using a serious game to learn environmental hazard and safety assessment	Serious game
Wang et al. [262]	2023	Enhancing anatomy education through cooperative learning: harnessing virtual reality for effective gross anatomy learning	VR-based learning system
Wang et al. [263]	2019	Student Perceptions of Classic and Game-Based Online Student Response Systems	Game-based learning systems

Table 2. *Cont.*

Author	Year	Title	Short Intervention Description [1]
Williams et al. [264]	2020	Teaching interprofessional competencies using virtual simulation: A descriptive exploratory research study	VR simulation
Wong et al. [265]	2022	Virtual ER, a Serious Game for Interprofessional Education to Enhance Teamwork in Medical and Nursing Undergraduates: Development and Evaluation Study	Virtual serious game
Wu et al. [266]	2023	Learning with Immersive Virtual Reality: An Exploratory Study of Chinese College Nursing Students	Immersive VR simulation
Wu et al. [267]	2022	A pediatric seizure management virtual reality simulator for nursing students: A quasi-experimental design	Gamified VR simulation
Wu et al. [268]	2020	Effect of virtual reality training to decreases rates of needle stick/sharp injuries in new-coming medical and nursing interns in Taiwan	Game-based VR training
Xiwei et al. [269]	2023	Evaluation of Gamification on Surgical Nursing Course using Immersive Virtual Reality: A comparative study	Gamified immersive VR
Yang et al. [270]	2023	Facilitating undergraduate students' problem-solving and critical thinking competence via online escape room learning	Online game-based escape room
Yang et al. [271]	2022	The effects of neonatal resuscitation gamification program using immersive virtual reality: A quasi-experimental study	Immersive VR gamified
Yeh et al. [272]	2022	Effectiveness of e-STORY App in clinical reasoning competency and self-directed learning among students in associate nursing program: A quasi experimental study	Mobile app with digital diagrams
Yeo et al. [273]	2023	Nursing students' self-directed learning experiences in web-based virtual simulation: A qualitative study	Web-based VR simulation
Yildiz et al. [274]	2022	A. Virtual reality in nursing education 3D intravenous catheterization E-learning: A randomized controlled trial	VR simulation
Yu et al. [275]	2021	Development of Virtual Reality Simulation Program for High-risk Neonatal Infection Control Education	Immersive VR simulation
Yu et al. [276]	2021	Effects of Virtual Reality Simulation Program Regarding High-risk Neonatal Infection Control on Nursing Students	VR simulation
Yu et al. [277]	2022	Effectiveness and Utility of Virtual Reality Infection Control Simulation for Children With COVID-19: Quasi-Experimental Study	VR simulation
Yuqun et al. [278]	2023	Application of Virtual Simulation Technology in Human Anatomy Teaching in 5G Environment	Virtual simulation
Zhang [279]	2023	Development and Application Practice of Nursing Simulation Experiment Teaching Platform Under VR Technology	VR simulation
Zhang et al. [280]	2023	Development and Application Evaluation of a Nursing Simulation Teaching Information System Based on Hospital Information Systems	Simulation system
Zugai et al. [281]	2022	Online Gamified Quizzes in Undergraduate Mental Health Nursing Education: Thematic Analysis of Students' Qualitative Views	Gamified activities

[1] Short description according to what authors stated in title, abstract, or methods section of their studies (in the majority of cases).

Altogether, more than 22,500 undergraduate nursing students participated in the enrolled studies. This number derives from 248 studies that clearly stated the actual

number of undergraduate nursing students included within their sample (enrolling nursing students solely or including both nursing students and nursing faculty members/graduate students or undergraduate students from other healthcare faculties). Moreover, two articles with zero participants were included [259,275]; however, those studies had published previous articles enrolling undergraduate nursing participants that had already been included in the present review. To calculate the overall sample size, we excluded studies that: (1) did not provide a clear number of participants [64,66,100,117,128,135,177,279], (2) utilized the same digital tool and exact same sample size as a previous publication [31, 170,188,231], (3) enrolled nursing and other healthcare students or nursing faculty without clearly separating the number of participants in each group [103,179,220,238]. Upon these adjustments, the exact number of enrolled nursing students was estimated at 22,768.

Furthermore, we were able to identify 173 studies that provided information about the study cycle in which the nursing students were enrolled during the digital tool intervention. Both first-year students and sophomore students were enrolled in 42 studies each. Third-year students participated in 22 studies, while fourth-year students were engaged in 35 studies. Moreover, 29 studies utilized participants from different nursing cycles and three studies enrolled students from all nursing studies cycles. In 93 studies, relevant information was not provided.

In addition, 39 studies utilized a varied sample of participants, not just nursing undergraduate students. More specifically, 14 studies also enrolled nursing faculty members or nursing graduate students/nursing master students. Furthermore, 25 studies were identified also involving undergraduate healthcare students from other disciplines (medicine, midwifery, social work, occupational therapy, etc.). Moreover, 23 studies emerged that were conducted among multiple nursing education sites (different universities/colleges/institutions/schools). Furthermore, as mentioned above, two studies took place among nursing schools located in different countries.

To answer the first research question, we located and removed studies (within the realm of possibility) reporting on the same digital tool in more than one publication throughout the five-year study period. Therefore, upon excluding 34 studies, we estimate that 232 different digital tools have been implemented in the past five years with the aim of enhancing undergraduate nursing education. Studies that, to the best of our judgment, were identified utilizing the same digital tool are listed in Appendix A (Table A1). Those digital tools may present small alterations among the different publications; however, the digital environment and basic concept behind the intervention remain the same (e.g., better graphics enhancement, new add-ons, different nursing scenarios, etc.). Therefore, they were excluded from this analysis in order to achieve a closer approximation to reality.

In order to answer the second research question, we categorized the studies according to their implementation sites. Consequently, 34 different countries from all five continents were identified. In Figure 2, the countries are depicted along with chromatic information regarding the number of published articles per country (the darker the color, the greater the number of publications). Among the top five countries that hailed as pioneers in utilizing digital tools for undergraduate nursing education were the USA (50 articles), South Korea (37 articles), China—including Hong Kong (20 articles), Spain (20 articles), and Taiwan (19 articles). Furthermore, two studies utilized an international sample size; one included Italian and Irish nursing students [67], and another included nursing students from Canada, the United Kingdom (including Scotland), and Australia [93]. Analytical information on the number of studies each country yielded along with references to the relevant articles can be found in Appendix A (Table A2).

To answer the third research question, we categorized the emerging digital tools into three broad groups according to the game characteristics display level. Hence, the first category involves applications that were designed purely as games and can be characterized as standalone online training activities with clear serious game design elements. The tools in this category should combine all or most of the below characteristics: game environment, player/game characters, rules, storyline, challenges, achievements/points,

controls, interaction, and feedback. In the second category, we placed gamified tools and applications that might display several characteristics of gamification, but their entire design and development process did not extend the notion of a discrete serious game. In this category, we included applications with various gamification characteristics and an overall game-like feeling (e.g., gamified graphics environment, decision-making actions, leaderboards, feedback) that could closely resemble serious game design. In addition, this category incorporates other digital applications displaying basic gamification elements (leveling up activities, points allocation, badges, mini quizzes, etc.). In the third category group, digital tools and virtual simulations designed to enhance nursing education presenting very limited gamification characteristics or without displaying any gamified features and techniques were included. In these applications, the user interaction with the environment was limited (e.g., 3D environments without gamified design, digital learning management systems, etc.). According to the above classification, 77 studies were characterized as "serious games" interventions, 93 studies were classified as "gamified applications", and 96 studies displayed "low or non-gamified digital interventions and VR simulations". Excluding multiple publications on the same digital tool, the results were as follows: serious games, 66 studies (28%); gamified applications, 79 studies (34.5%); and low or non-gamified digital interventions and VR simulations, 87 studies (37.5%). Table 3 presents frequency and percentage per category along with the relevant study reference number.

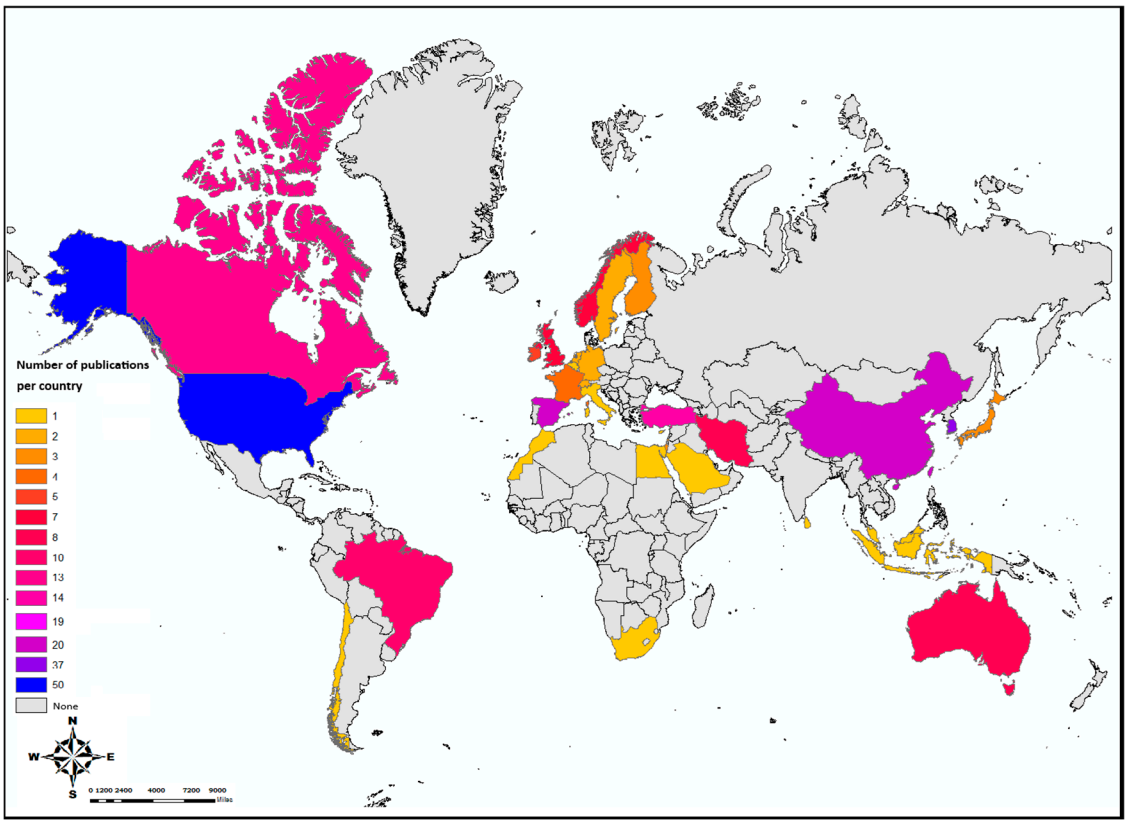

Figure 2. Number of studies published on digital tools for undergraduate nursing education per country.

Moreover, a further categorization was attempted according to the type of learning activity implemented by the identified digital tool/application. To this end, the categories formed were classified into eight broad groups: 1) simulation, 2) storytelling/video storytelling, 3) quizzes, 4) puzzles (escape rooms, card games, memory games, matching games, treasure hunt games), 5) decision-making, 6) resource management, 7) role-playing games, and 8) others (platforms, learning systems, etc.). Some digital tools presented multiple learning activity characteristics, therefore have been classified as more than one of the

above categories (Table 4). Digital tools with multiple publications have been excluded in order to avoid over-representation of specific learning type activities. To this end, we chose to include the most recent publication per digital tool in case it has developed add-on features or extra learning activities throughout the years.

Table 3. Classification of digital tools according to game design display level.

Game Design Display Level	Frequency (%) [1] N = 232 (100)	Studies References [2] N = 266
Serious games	66 (28.0)	[16–18,24,25,28,29,32,34,36,38,41,42,44,46,49,51,63,68,69,74–76,78,80,82,89,92,96,97,104,106,112–114,117,123–125,135,136,139,140,152,161,165,166,169–173,179,181,187,188,190,192,193,201,207–210,212,213,215,224,225,245,249,252,259–261,265,270]
Gamified apps/tools	79 (34.5)	[19,21,23,26,37,39,40,45,47,50,53,56–58,62,67,71,79,86,95,98,99,101,105,110,115,116,120,127–130,137,138,141–143,145,147,151,154–160,164,167,168,180,182–186,191,194,198,200,202,204,211,219–222,229–234,237–239,244,250,251,253,254,257,258,263,266–269,271,273,274,277,281]
Low or non-gamified interventions and VR simulations	87 (37.5)	[20,22,27,30,31,33,35,43,48,52,54,55,59–61,64–66,70,72,73,77,81,83–85,87,88,90,91,93,94,100,102,103,107–109,111,118,119,121,122,126,131–134,144,146,148–150,153,162,163,174–178,189,195–197,199,203,205,206,214,216–218,223,226–228,235,236,240–243,246–248,255,256,262,264,272,275,276,278–280]

[1] Multiple studies reporting on the same digital tool are counted as one. [2] Studies reporting on the same digital tool are not excluded.

Table 4. Categorization according to the type of learning activity implemented by the identified digital tool/application.

Learning Activity Type	Frequency (%) [1] N = 232 293 (100)	Studies References [2] N = 266
Simulation	126 (43.0)	[19–23,26,27,29–33,35–37,39,43,44,46–48,50,52–54,56–59,62,64,65,72,74–76,80,81,83,88,90–94,98,100,101,104,106,108,111,117–120,122,123,125,126,131–133,136,138–142,144,147,148,153–160,162,164,170,174–178,186,189–194,196–200,202,204,209,216–220,222,223,225,226,228,230–233,235–242,244,245,247,248,250,251,256,258–260,262,264,266,267,269,271,273–280]
Storytelling/ video storytelling	31 (10.6)	[18,55,60,61,66,70,73,77,82,85,87,90,91,102,103,105,107,109,121,127,130,146,149,150,162,163,165,183–185,195,203,227,243,246,255]
Quiz	47 (16.0)	[18,25,38–41,45,50,67,68,79,82,86,92,95,97,110,115,116,120,124,125,128,130,137,141,143,161,165,167,172,173,179,182–184,186,193,198,202,211,229,234,237,257,260,263,268,281]
Puzzle	31 (10.6)	[17,24,25,32,34,38,42,58,63,69,86,96–99,126,134,135,152,168,169,173,181,204,207,208,215,221,224,249,252–254,270,272]
Decision-making	36 (12.3)	[16,27,28,34,46,47,51,69,74–76,78,84,89,92,106,125,127,136,142,147,151,157–159,170,171,174,175,187,188,190,194,198,201,209,210,212,213,217,238,239,244,259–261,268]
Resource management	12 (4.1)	[49,71,112,113,180,187,188,201,214,229,261,265,272,275,276]
Role-playing	7 (2.4)	[49,51,101,114,145,154–156,160,166]
Other	3 (1.0)	[129,167,205,206]

[1] Multiple studies reporting on the same digital tool are excluded. [2] Studies reporting on the same digital tool are not excluded.

Furthermore, 13 teamwork-based learning activities were identified [28,59,71,97,137,160,177,208,211,224,231,262,265], including digital escape rooms, an AR treasure hunt game, resource management activities, quizzes, puzzles and several team-based VR simulations. Many of the above studies had published more than one article [86,154–156,207,230,233].

Regarding the fourth research question, almost every digital tool specified the nursing subject whose knowledge absorption it aimed to support and enrich. In only three studies [211,221,263] was the information insufficient to safely conclude the targeted subject. Accordingly, digital tools were categorized into 12 broad thematic categories according to their teaching subject: (1) clinical procedures—clinical practice, (2) adult nursing, (3) pedi-

atric nursing, (4) women and infant care, (5) medication, (6) mental health, (7) community health and primary care, (8) disaster/emergency/first aid care, (9) intensive—critical care, (10) nursing fundamentals and core assessment skills, (11) soft skills, (12) other subjects or not specified. Table 5 summarizes these thematic groups and reports on the included subjects per category. Among the digital tools' most common teaching subjects were those related to clinical procedures and clinical practices (n = 81), subjects related to adult nursing care (n = 45) and subjects aiming to enhance nursing students' soft skills acquisition (n = 28).

Table 5. Nursing subjects classified according to thematic category.

Thematic Categories	Nursing Subjects Targeted by the Digital Tools/Applications
Clinical procedures—clinical practice	(1) intradermal injections and intravenous injections, (2) intravenous therapy and subcutaneous injection procedures, (3) insulin injection and intravenous therapy, (4) intravenous injection, (5) intravenous injection, (6) medication injection, (7) injection applications, (8) intramuscular injection, (9) clinical reasoning skills, (10) problem-solving and clinical reasoning, (11) engagement and synthesis of clinical information, (12) clinical surveillance skills, (13) pre-clinical practices, (14) clinical hours/experience, (15) clinical judgment/experience, (16) clinical skills, (17) surgical nursing knowledge and skills, (18) clinical nursing skills, (19) clinical judgment, (20) clinical reasoning skills, (21) clinical reasoning skills, (22) clinical reasoning skills in a resuscitation situation, (23) managing clinical deterioration, (24) clinical deterioration recognition, (25) endotracheal suctioning procedure, (26) techniques of heart/lung assessment, (27) medication administration and nasotracheal suctioning, (28) clinical decision-making, (29) clinical skills, (30) emerging clinical readiness, (31) clinical skills, (32) clinical skills, (33) response to rapidly deteriorating patient, (34) clinical practice, (35) clinical reasoning, (36) clinical decision-making, (37) electrocardiogram interpretation, (38) interpreting electrocardiogram readings, (39) airway management, (40) management and nursing administration/ethics, (41) sputum suction, (42) developing personalized care plan for patients, (43) work organization, (44) decreasing the rates of needlestick or sharp injury, (45) objective structured clinical examination, (46) blood transfusion, (47) venous blood specimen collection, (48) decision-making, (49) managing common clinical conditions, (50) care decision-making, (51) basic physical assessment skills, (52) vital signs, (53) carrying out vital signs, (54) identifying infectious sites in a hospital room setting, (55) asepsis training, (56) indwelling catheterization, (57) infection prevention and control related to catheter-associated urinary tract infection, (58) venous catheters, (59) intravenous catheterization and fluid delivery, (60) sterile catheter insertion, (61) intravenous catheterization skills, (62) sterile urinary catheter training, (63) wound dressing, (64) wound dressing, (65) wound treatment, (66) surgical instruments and equipment, (67) surgical instruments and equipment, (68) medical and nursing instruments, (69) mechanical ventilation, (70) education on inhaler devices, (71) chest tube care, (72) nasogastric intubation, (73) nasogastric tube feeding, (74) nasogastric tube feeding, (75) nasogastric tube care, (76) tracheostomy care, (77) chemoport insertion surgery, (78) leg ulcer care, (79) leg ulcer care, (80) pressure ulcers, (81) pressure injuries
Adult nursing	(1) nursing care for arrhythmia, (2) acute heart failure recognition and management, (3) anatomy and physiology of the heart, pathophysiology and care of patients with heart failure, (4) myocardial infarction care, (5) geriatric care, (6) gerontological nursing experiences/empathy, (7) gerontological care, (8) diet and nutrition, (9) dietetics and nutrition, (10) care of patients with COVID-19, (11) COVID-19 care, (12) COVID-19 education, (13) respiratory infectious diseases—COVID-19, (14) rehabilitation, (15) rehabilitation nursing, (16) hypoglycemia—diabetes, (17) diabetes, (18) diabetes, (19) diabetes education, (20) recognition and management of an acute diabetic emergency, (21) Alzheimer's/dementia knowledge, (22) dementia/Alzheimer's disease, (23) chronic obstructive pulmonary disease care, (24) asthma/chronic obstructive lung disease, (25) sexually transmitted disease/infection treatment and counselling, (26) testicular diseases, (27) tailored care to cancer survivors, (28) chemotherapy administration, (29) stroke assessment, (30) human-centered care, (31) caring for patients with chronic disease, (32) pain assessment, (33) pain management, (34) care for delirious patients, (35) delirium patients, (36) post-operative delirium, (37) preoperative care, (38) postoperative patient nursing, (39) perioperative nursing, (40) post-operative care, heart failure, and fluid volume overload, (41) operating room placement preparation, (42) perioperative nursing, (43) preoperative surgical procedures, (44) post-operative care, (45) preoperative surgical concepts and procedures

Table 5. *Cont.*

Thematic Categories	Nursing Subjects Targeted by the Digital Tools/Applications
Pediatric nursing	(1) pediatric first aid practices, (2) pediatric nursing, (3) pediatric care, (4) pediatric sputum suction, (5) measuring vital signs in children, (6) child-adolescent nursing, (7) pediatric clinical practice, (8) pediatric seizure management, (9) pediatric/obstetric clinical practice, (10) nursing care for children with asthma, (11) pediatric nursing knowledge and skills, (12) personal protective equipment and respiratory care for COVID-19 pediatric patients
Women and infant care	(1) maternity-related knowledge, (2) training for premature rupture of membrane care, (3) childbirth skills, (4) antepartum assessment training, (5) neonatal infection control, (6) neonatal infection control, (7) assessment of prenatal client, (8) development of the five senses in mother's womb/embryology, (9) pediatrics, mental health, maternal health, and emergency, (10) developmental care of infants in neonatal intensive care units, (11) neonatal resuscitation, (12) neonatal resuscitation, (13) first aid for infant airway obstruction, (14) Leopold's maneuvers
Medication	(1) medication preparation and administration, (2) medication administration, (3) communicating with patients about complementary and alternative medicine use, (4) medication errors, (5) medication administration procedures, (6) medication administration guidelines, (7) cardiovascular pharmacology, (8) pharmacology, (9) pharmacology, (10) medication management
Mental health	(1) mental health, (2) mental health, (3) mental illness, (4) mental health (treatment competence for patients with schizophrenia), (5) care for schizophrenic patients, (6) depression and schizophrenia, (7) severe mental illness awareness, (8) communication with patients with psychiatric symptoms
Community health and primary care	(1) determinants of health, (2) in-home family assessments, (3) community clinical learning experiences, (4) environmental hazard and safety assessment, (5) home visit, (6) home and environmental patient safety, (7) vaccination, (8) lesbian, gay, bisexual, transgender, queer and intersexual (LGBTQI) health care, (9) adolescent screening, brief intervention, and referral to treatment for substance use
Disaster/emergency/first aid care	(1) triage decision-making in an immersive mass incident, (2) mass casualty incident victim triage simulation, (3) emergency triage, (4) triage skills, (5) disaster skills, (6) cardiopulmonary resuscitation, (7) cardiopulmonary resuscitation, (8) disaster response, (9) disaster evacuation management, (10) crisis and disaster management, (11) management of a patient in the emergency room, (12) nursing principles in disaster situations, (13) building evacuation in fire, (14) operating room fire safety skills, (15) basic life support in an emergency situation, (16) managing a patient with a foreign object in the airway, (17) Airway, Breathing, Circulation, Disability, Exposure (ABCDE) approach, (18) ABCDE approach for recognizing deterioration, (19) sorting patient information according to Identification-Situation-Background-Assessment-Recommendation (ISBAR), (20) life support techniques
Intensive—critical care	(1) critical care internship, (2) nursing care of a critically ill patient in Intensive Care Unit, (3) care of the acutely unwell, (4) responding to opioid-involved overdose, (5) signs and symptoms of an opioid-related overdose and immediate recovery care
Nursing fundamentals and core assessment skills	(1) nursing models and theories, (2) core nursing skills, (3) nursing competencies, (4) nursing skills competency, (5) knowledge/compliance of standard nursing precautions, (6) fundamental nursing skills, (7) symptoms identification, (8) nursing diagnosis, goal setting and diagnosis prioritization, (9) nursing diagnosis/clinical practice, (10) severity classification competency, (11) nursing semiology and semiotics, (12) basic process of nursing research, (13) health assessment, (14) patient safety, (15) patient safety education, (16) patient safety management, (17) pathophysiology and comprehensive health assessment modules, (18) physiology, (19) anatomy, (20) anatomy knowledge and skills, (21) skeletal system and anatomy of the heart, (22) anatomy and human physiology, (23) anatomy and physiology, (24) human anatomy/heart anatomy, (25) neurological assessment, (26) neurologic examination, (27) neurotransmitters in health and human physiology

Table 5. *Cont.*

Thematic Categories	Nursing Subjects Targeted by the Digital Tools/Applications
Soft skills	(1) empathy, (2) empathy (toward older adults), (3) interpersonal skills—empathy, (4) communication skills and empathy, (5) communication skills, (6) communication skills, (7) communication skills training, (8) communication efficacy, (9) communication skills and breaking bad news, (10) ethical reflection and communication, (11) cross-cultural communication skills, (12) cultural humility, (13) awareness of civility and incivility, (14) therapeutic communication skills, (15) communication competence, (16) interprofessional team training (communication skills and teamwork attitude), (17) interprofessional education, (18) interprofessional training, (19) interprofessional team care delivery, (20) interprofessional competency knowledge, (21) interprofessional education in primary care, (22) interprofessional communication skills, (23) interprofessional competencies of communication and teamwork, (24) sepsis knowledge and self-efficacy in interprofessional communication, (25) teamwork attitude enhancement, (26) collaborative problem-solving skills, (27) problem-solving competencies, (28) work scheduling, situation awareness, and decision-making
Other subjects/ not specified	(1) English language learning, (2) English vocabulary, (3) multilingual learning—German, (4) mathematics, (5) not specified, (6) not specified, (7) not specified

As regards the implementation of digital tools within a specific nursing course curriculum, 108 studies were identified providing relevant information. Upon classification, courses were categorized into 12 groups quite similar to the categories previously developed for the learning subjects. The course categories are as follows: (1) clinical procedures—practice, (2) adult nursing, (3) pediatric nursing, (4) women and infant care, (5) mental health, (6) public/community health and primary care, (7) emergency care and disaster medicine, (8) intensive-critical care, (9) nursing fundamentals and aligned core sciences, (10) medical-surgical nursing, (11) other courses, and (12) multiple courses (digital tools that were implemented simultaneously in more than one nursing course). According to the classification (Table 6), the courses that most often utilized digital tools to enhance nursing students' learning experience were nursing fundamentals and aligned core sciences (n = 27), clinical procedures and clinical placement courses (n = 19), and courses related to adult nursing (n = 12).

Table 6. Nursing courses classification.

Course Categories	Nursing Courses That Utilized Digital Tools/Applications
Clinical procedures—practice	(1) clinical course, (2) clinical nursing course, (3) seminar for clinical case studies course, (4) semiology, semiotechnics, and care process course, (5) clinical placement course, (6) course clinical placements, (7) clinical apprenticeship, (8) integrated practicum, (9) first medical-surgical hospital rotations course, (10) clinical rotation course, (11) nursing internship, (12) nursing practice in hospital, (13) clinical nursing I course, (14) clinical nursing I course, (15) nursing physical assessment course, (16) introductory nursing laboratories course, (17) health assessment course, (18) health assessment practice course, (19) venous indwelling needle course
Adult nursing	(1) adult health I course, (2) adult health clinical course, (3) nursing of adults course, (4) adult nursing and practice course, (5) adult health II course, (6) diabetes nursing course, (7) geriatric care course, (8) geriatric nursing course, (9) gerontological nursing course, (10) gerontological nursing course, (11) gerontology nursing course, (12) dietetics and nutrition course
Pediatric nursing	(1) pediatric clinical course, (2) pediatric nursing course, (3) pediatric clinical course, (4) pediatric/obstetrics course
Women and infant care	(1) maternity course, (2) course of clinical practicum of maternity nursing, (3) nursing care of women, families and newborns
Mental health	(1) mental health course, (2) mental health nursing course, (3) psychiatric nursing
Public/community health and primary care	(1) public health course, (2) public health nursing course, (3) population health nursing course, (4) home healthcare course, (5) community healthcare course, (6) community health course, (7) family assessment course, (8) health assessment course/family assessment

Table 6. *Cont.*

Course Categories	Nursing Courses That Utilized Digital Tools/Applications
Emergency care and disaster medicine	(1) emergency and crisis management course, (2) emergency nursing care course, (3) emergency disaster course, (4) disaster nursing course, (5) trauma and disaster nursing course, (6) basic and advanced life support course, (7) basic and advanced life support course, (8) help and rescue curriculum, (9) first aid training (not an official course)
Intensive—critical care	(1) critical care nursing course, (2) critical care nursing course, (3) critical care course, (4) critical illness patient care course
Nursing fundamentals and aligned core sciences	(1) nursing fundamentals course, (2) nursing fundamentals course, (3) nursing fundamentals course, (4) fundamentals of nursing, (5) fundamentals of nursing course, (6) fundamentals of nursing course, (7) fundamentals of nursing course, (8) fundamentals of nursing II course, (9) fundamentals of nursing II course, (10) fundamentals of nursing II course, (11) nursing course 1 and 2, (12) principles of nursing course, (13) principles of personalized nursing care 2, (14) internal medicine course, (15) nursing management, (16) nursing course, (17) basic nursing skill course, (18) clinical pharmacology course, (19) pharmacology course, (20) pharmacology course, (21) complementary and alternative medicine course, (22) anatomy, physiology, and health assessment course, (23) anatomy course, (24) human anatomy course, (25) human anatomy course, (26) human physiology course, (27) physiology course
Medical-surgical nursing	(1) medical-surgical course, (2) medical-surgical nursing course, (3) medical-surgical II course, (4) advanced medical-surgical nursing course, (5) surgical nursing course, (6) advanced medical-surgical nursing course, (7) medical-surgical nursing I course, (8) medical-surgical course, (9) perioperative nursing course
Other	(1) English course, (2) English course, (3) nursing informatics, (4) statistics and information systems course, (5) nursing research course, (6) philosophy of life, values, and relationships in professional practice, (7) management and administration of nursing, ethics and health legislation services
Multiple courses simultaneously	(1) pain assessment course & home assessment course & global citizens course, (2) pathophysiology & pharmacology & nursing practice I, (3) fundamentals course & traditional medical-surgical I course & accelerated medical-surgical I course & mental health course

4. Discussion

To the best of our knowledge, this is the first review of nursing education digital tools utilizing such a broad search algorithm with multiple keywords and key phrases resulting in the astonishing number of 266 relevant results. The present findings suggest that nursing education digitalization has indeed played an important role in the past five years in enhancing and advancing the nursing curriculum in several countries around the globe.

Furthermore, it became evident that digital educational tools for nursing education increased tremendously, especially after 2021. According to our results, a greater than four-fold increase was observed in relevant publications between 2019 (n = 18) and 2023 (n = 84). This phenomenon is mainly attributed to the COVID-19 pandemic that forced integration of digital tools into the nursing curriculum to support distance learning for undergraduate students [282–284]. However, we should also recognize the significant technological advancements in teaching techniques and learning methodologies that have been achieved in recent years with the aim of enhancing educational experiences [285]. To this end, the latest digital technologies have caused a paradigm shift in the education system by providing knowledge but also being a co-creator of information, acting both as mentor and assessor [286].

The present review reported on three main digital educational tool types for nursing education: serious games, gamified applications, and non-gamified tools or virtual simulations. Indeed, serious games are an emerging learning approach in digital education [287] and there are recent reviews reporting on the implementation of serious games in undergraduate nursing education. However, their results were far more limited; one review reported eight relevant studies published from 2015–2021 [288], while another included 22 studies published within 2010–2021 [12]. Although these studies examined multiple

databases, this review searched only one and yielded 66 relevant results (upon excluding multiple publications of the same serious game). It is highly plausible that the major part of the observed difference is attributed to the implemented search algorithm, but we also cannot neglect the fact that, although the other reviews were recently published, they did not include studies published after 2022.

Furthermore, educational usage of digital simulations and gamified applications has increased worldwide, since they are considered effective educational tools that can improve learning experience at all educational levels, subjects, and contexts [289]. Two previous systematic reviews on the utilization of gamification in nursing undergraduate education reported 17 relevant studies from four countries (2017–2022) [290] and 46 relevant studies from 15 countries (2000–2020) [13]. According to our results, 79 gamified applications and tools were identified. Similarly to the prior observation, search algorithm quality and study period are expected to have significantly impacted the observed difference.

Moreover, our findings yielded 87 studies reporting on low or non-gamified interventions and digital simulations for undergraduate nursing education. The only similar study in the literature, the results of which can be compared to ours, is that of Dicheva et al. [284], which reviewed 78 articles on computer-aided nursing pedagogies, published between 2013 and early 2023. However, the fact that the inclusion and exclusion criteria of this review differed compared to ours (excluding studies with immersive VR/online platforms/blended learning as well as studies without a control group), while at the same time their results include serious games and gamified applications, should be taken under serious consideration.

As has emerged from the present review, several countries around the globe have designed, developed, and implemented digital educational tools into their nursing curriculum to a greater or lesser extent. Our results indicate that 34 different countries worldwide have attempted to enhance nursing undergraduate learning by utilizing at least one digital tool in the nursing curriculum. However, it became clear that digitalization of nursing tools is not spread evenly around the world; there are many developed or developing countries that have not yet invested in digital educational technology to enhance undergraduate nursing students' engagement and motivation. Those countries are located both in Europe (e.g., eastern Europe) and Latin America, as well as other less-developed world regions. Past reviews report lower geographical dispersion [13,290], while the highest geographical range previously observed is 20 countries [284]. In this study, the USA, Taiwan, Spain and South Korea were also recognized as the countries with the largest distribution of relevant publications [284].

Undoubtedly, simulation type activities constitute an important teaching method and effective strategy for understanding theoretical knowledge and learning practical skills in nursing education [291]. Therefore, simulation-based learning is identified as a key component in undergraduate nursing programs, as it assists in preparing nursing students for safer clinical placement [292]. Particularly, virtual simulation is an emerging innovation accelerated by the COVID-19 pandemic and is now embedded in several nursing pedagogy practices [293]. The present findings confirm that simulation type activities have the lion's share among the identified nursing digital tools, since almost half of the included studies (43%) were based on or included digital simulation type activities. Also, according to the present review results, quizzes are also frequently utilized in the enrolled studies to enhance nursing education experiences (16%). The literature reports that quiz type activities are readily acceptable tools which complement medical lectures and improve students' learning and comprehension by promoting healthy competition and peer-assisted learning [294]. Previous studies in nursing students have established that the use of quizzes can promote academic success and enhance long-term retention of the learning material [295]. Finally, decision-making activities was a common topic among the identified digital nursing tools (12.3%), since it is considered one of the most essential soft skills in nurses' daily practice [296]. In a nutshell, decision-making in nursing comprises the process of selecting an action from various possible alternatives to address a clinical

situation, including gathering and interpreting information, weighing the cost–benefit of each alternative, and selecting a course of action [297]. The literature indicates that clinical reasoning and decision-making can be safely practiced by nursing students in a realistic and secure environment via serious games and gamified applications which can be incorporated in the nursing education curriculum [86].

As regards the most common educational subjects, the majority of the identified digital nursing tools (n = 81) were related to nursing clinical procedures and clinical practice (e.g., injection therapy, wound/ulcers treatment, proper medical equipment usage and other clinical reasoning skills). This observation was expected, since several virtual simulations have been designed and implemented with the aim of enhancing clinical reasoning in nursing education [298], especially during the COVID-19 pandemic when pivoting to virtual simulation for clinical practice was a one-way road [299]. Another frequently addressed subject that emerged was adult nursing (n = 45), which is a broad category including digital tools aiming, among others, at enhancing chronic diseases management (e.g., diabetes, heart diseases, respiratory diseases, cancer), geriatric care (including Alzheimer's disease and dementia), and COVID-19 care. Finally, several of the identified tools (n = 28) were related to soft skills acquisition (such as communication skills, empathy and interprofessional teamwork competencies). Many studies have underlined the need for implementing soft skills training in undergraduate nursing programs, especially since human interaction (e.g., a subtle smile, a soothing touch) is among the few things that technology cannot replace [300]. A recent review highlighted the need for incorporating soft skills learning strategies in undergraduate nursing education while it showcased that simulation-based learning strategies are widely used in order to enhance soft skills learning acquisition [296].

From the present review, it becomes evident that nursing digital learning tools have flourished during the past five years and there are now several serious games, gamified applications and digital/virtual tools designed for undergraduate nursing students. Especially after the COVID-19 pandemic, the increase is exponential and the present results showcase that every country, every university and every nurse tutor has several options to choose from in order to update and enhance the existing nursing curriculum. The aim of this review was to synthesize information from all the available digital tools, in order to inspire and stimulate the readers to actively engage and embrace digital technologies in nursing education and reap its multiple benefits. There are several ideas in this article regarding the type of learning activities, the available digital technologies, and the enrolled learning subjects and courses that can act as a useful blueprint and motivate all relevant stakeholders (ministries of education, deans of nursing schools, nurse educators) to invest in serious games, gamification and digital technologies and start developing a new digitalized nursing education era step-by-step.

Limitations

This review comes with some limitations. Initially, the fact that only one database was reviewed may have limited the number of potential results. However, we searched the most relevant scientific database utilizing a robust search algorithm that yielded an astonishing number of studies which is much higher than the findings reported in previous reviews conducted in multiple databases. Moreover, another limitation lies within the classification criteria for certain categories (game types, learning activity types, subject themes, and course categories). These categories have a scientific basis indeed; however, due to the large number of results and the heterogeneity of the reported information, we improvised to a certain extent in order to be able to report the data in homogenous categories/groups. Also, another limitation is that due to the large number of returned results (N = 1592) and included results (n = 266), slight misinterpretations or errors might have occurred during the review and data extraction process. However, since there is a large number of studies, some minor inaccuracies are not expected to have created significant imbalances within the reported information.

5. Conclusions

The present findings highlight that digital educational tools are an emerging field identified as a potential pedagogical strategy aiming to transform nursing education. This review underlines the latest advances in the area of nursing education, providing useful insights that could inspire countries and universities that haven't yet incorporated digital educational tools in their nursing curriculum, to invest in their implementation. However, this review did not report on the effectiveness and efficacy of the digital tools, since many individual studies or systematic reviews have concluded that it provides several advantages in improving learning outcomes and creating a more engaging and fun environment for the students. Moreover, several studies were identified reporting on the implementation of digital tools within a specific curriculum nursing course. Future research should examine long-term effects of incorporating digital tools as an integral part of the nursing curriculum. In addition, blueprint studies on developing and implementing digital educational tools in nursing schools with scarce or limited resources are needed in order to ensure that progress can be achieved in every university and benefits can be reaped by nursing students. A final suggestion for authors is to include photos from their games and applications in their articles, since they are very helpful in visualizing the information provided in their manuscripts.

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Appendix A

Table A1. Studies identified as utilizing the same digital tool and/or participants' sample.

Studies Utilizing the Same Digital Tool	Studies Utilizing the Same Digital Tool & the Same Participants' Sample
[17,181]	
[30,31]	[30,31]
[56,57]	
[58,98]	
[60,61,149]	
[74–76]	
[86,97]	
[90,91]	
[102,103]	
[106,170]	[106,170]
[131,132]	

Table A1. *Cont.*

Studies Utilizing the Same Digital Tool	Studies Utilizing the Same Digital Tool & the Same Participants' Sample
[139,140]	
[154–157,160]	
[158,159]	
[174,175]	
[183,184]	
[187,188,201]	[187,188]
[192,193]	
[205,206]	
[207,208]	
[212,213]	
[230–233]	[230,231]
[238,239]	
[250,251]	
[259,260]	
[275,276]	

Table A2. Identified studies per country.

Country	Number of Studies	Studies References
Australia	8	[73,102,103,117,127,241,261,281]
Belgium	1	[58]
Brazil	10	[34,46,69,92,104,161,173,183,184,254]
Canada	13	[26,27,59,125,128,129,165,169,253,258–260,264]
Chile	1	[25]
China (including Hong Kong)	20	[62,63,96,99,112,113,137,146,152,177,186,236,248,252,265,266,269,278–280]
Cyprus	1	[257]
Egypt	1	[79]
Finland	3	[106,136,170]
France	4	[32,187,188,201]
Germany	2	[185,200]
Indonesia	1	[189]
Israel	3	[74–76]
Iran	8	[17,82,171,172,179,181,234,245]
Ireland	5	[16,68,105,219,220]
Italy	1	[87]
Japan	3	[174,175,180]
Malaysia	1	[126]
Malta	1	[95]
Morocco	1	[78]
Netherlands	2	[38,71]
Norway	7	[23,30,31,77,83,107,120]
Saudi Arabia	1	[222]
Singapore	13	[115,139,140,154–160,202,235,237]
Sri Lanka	1	[20]
South Africa	1	[35]

Table A2. *Cont.*

Country	Number of Studies	Studies References
South Korea	37	[21,47,60,61,119,121,122,130–134,141–145,147–151,191,196–198,228,229,242–244,249,271,273,275–277]
Spain	20	[24,45,81,85,86,97,176,182,205–213,215,221,224]
Sweden	2	[88,255]
Switzerland	2	[44,226]
Taiwan	19	[48–57,110,114,164,256,262,267,268,270,272]
Turkey (including North Cyprus)	14	[18,29,41,42,80,116,118,138,192,193,225,250,251,274]
United Kingdom (UK)	7	[89,124,195,204,218,238,239]
United States of America	50	[19,22,28,33,36,37,39,40,43,64–66,70,72,84,90,91,94,98,100,101,108,109,111,123,135,153,162,163,166–168,178,190,194,199,203,214,216,217,223,227,230–233,240,246,247,263]
Ireland & Italy	1	[67]
Canada, UK & Australia	1	[93]

References

1. Kowitlawakul, Y.; Tan, J.J.M.; Suebnukarn, S.; Nguyen, H.D.; Poo, D.C.C.; Chai, J.; Wang, W.; Devi, K. Utilizing educational technology in enhancing undergraduate nursing students' engagement and motivation: A scoping review. *J. Prof. Nurs. Off. J. Am. Assoc. Coll. Nurs.* **2022**, *42*, 262–275. [CrossRef] [PubMed]
2. Gentry, S.V.; Gauthier, A.; L'Estrade Ehrstrom, B.; Wortley, D.; Lilienthal, A.; Tudor Car, L.; Dauwels-Okutsu, S.; Nikolaou, C.K.; Zary, N.; Campbell, J.; et al. Serious Gaming and Gamification Education in Health Professions: Systematic Review. *J. Med. Internet Res.* **2019**, *21*, e12994. [CrossRef] [PubMed]
3. Verkuyl, M.; Violato, E.; Harder, N.; Southam, T.; Lavoie-Tremblay, M.; Goldsworthy, S.; Ellis, W.; Campbell, S.H.; Atack, L. Virtual simulation in healthcare education: A multi-professional, pan-Canadian evaluation. *Adv. Simul.* **2024**, *9*, 3. [CrossRef] [PubMed]
4. Billebot, M.N.; Cotteret, M.A.; Visier, P.; Noury, N.; Noat, H.; Picard, R.; Blot, N.; Fraudet, B. 4-Measurement and Knowledge in Health. In *Connected Healthcare for the Citizen*; Picard, R., Ed.; Elsevier: Amsterdam, The Netherlands, 2018; pp. 59–83. [CrossRef]
5. Deterding, S.; Dixon, D.; Khaled, R.; Nacke, L. From game design elements to gamefulness: Defining gamification. In Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments, Tampere, Finland, 28–30 September 2011. [CrossRef]
6. Dichev, C.; Dicheva, D. Gamifying education: What is known, what is believed and what remains uncertain: A critical review. *Int. J. Educ. Technol. High. Educ.* **2017**, *14*, 9. [CrossRef]
7. Turner, S.; Harder, N.; Vigier, D.; Cooper, A.; Mitchell, K. Lessons from implementing virtual simulations: A multi-program evaluation. *Clin. Simul. Nurs.* **2023**, *74*, 57–64. [CrossRef]
8. Forondo, C.L.; Fernandez-Burgos, M.; Nadeau, C.; Kelley, C.N.; Henry, M.N. Virtual simulation in nursing education: A systematic review spanning 1996 to 2018. *Simul Healthc.* **2020**, *15*, 46–54. [CrossRef]
9. Kalogiannakis, M.; Papadakis, S.; Zourmpakis, A.I. Gamification in Science Education. A Systematic Review of the Literature. *Educ. Sci.* **2021**, *11*, 22. [CrossRef]
10. Wang, Y.; Wang, Z.; Liu, G.; Wang, Z.Y.; Wang, Q.; Yan, Y.; Wang, J.; Zhu, Y.; Gao, W.; Kan, X.; et al. Application of Serious Games in Health Care: Scoping Review and Bibliometric Analysis. *Front. Public Health* **2022**, *10*, 896974. [CrossRef]
11. van Gaalen, A.E.J.; Brouwer, J.; Schönrock-Adema, J.; Bouwkamp-Timmer, T.; Jaarsma, A.D.C.; Georgiadis, J.R. Gamification of health professions. education: A systematic review. *Adv. Health Sci. Educ. Theory Pract.* **2021**, *26*, 683–711. [CrossRef]
12. 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]
13. 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] [PubMed]
14. Seah, B.; Ang, E.N.K.; Liaw, S.Y.; Lau, S.T.; Wang, W. Curriculum changes for pre-registration nursing education in times of COVID-19: For the better or worse? *Nurse Educ. Today* **2021**, *98*, 104743. [CrossRef] [PubMed]
15. 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 (Clin. Res. Ed.)* **2021**, *372*, n71. [CrossRef]
16. 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]
17. 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]
18. 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] [PubMed]
19. Aller, L.; Shelestak, D.; Phillips, L.; Reed, J.; Allen, B. Measuring Nursing Student Development through Computer-Based Simulation Activities. *Nurse Educ.* **2023**, *48*, 298–303. [CrossRef]
20. Aluthge, C.L.P.; Imeshika, K.A.S.; Weerasinghe, T.A.; Sandaruwan, K.D. Effectiveness of a VR-based Solution to Improve Practical Skills of Trainee Nurses in Sri Lanka. In Proceedings of the 2022 International Research Conference on Smart Computing and Systems Engineering (SCSE), Colombo, Sri Lanka, 1 September 2022; pp. 42–48. [CrossRef]
21. An, J.; Oh, J.; Park, K. Self-Regulated Learning Strategies for Nursing Students: A Pilot Randomized Controlled Trial. *Int. J. Environ. Res. Public Health* **2022**, *19*, 9058. [CrossRef]
22. Anbro, S.J.; Szarko, A.J.; Houmanfar, R.A.; Maraccini, A.M.; Crosswell, L.H.; Harris, F.C.; Rebaleati, M.; Starmer, L. Using virtual simulations to assess situational awareness and communication in medical and nursing education: A technical feasibility study. *J. Organ. Behav. Manag.* **2020**, *40*, 129–139. [CrossRef]
23. Andreasen, E.M.; Berg, H.; Steinsbekk, A.; Høigaard, R.; Haraldstad, K. The effect of using desktop VR to practice preoperative handovers with the ISBAR approach: A randomized controlled trial. *BMC Med. Educ.* **2023**, *23*, 983. [CrossRef]
24. 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 aFIRST year module: A cross-sectional study. *Nurse Educ. Today* **2022**, *118*, 105527. [CrossRef]
25. 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]
26. Azher, S.; Cervantes, A.; Marchionni, C.; Grewal, K.; Marchand, H.; Harley, J.M. Virtual Simulation in Nursing Education: Headset Virtual Reality and Screen-Based Virtual Simulation Offer A Comparable Experience. *Clin. Simul. Nurs.* **2023**, *79*, 61–74. [CrossRef]
27. Banville, F.; Milhomme, D.; Perron, A.; Pinard, J.; Houle, J.; Therrien, D.; Peguero-Rodriguez, G.; Charette, S.; Ménélas, B.-A.; Trépanier, M.; et al. Using Virtual Reality to Improve Nurses' Students' Clinical Surveillance in a Critical Care Context: A Psychological Perspective on Learning. *Annu. Rev. CyberTherapy Telemed.* **2023**, *21*, 245–251. [CrossRef]
28. 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]
29. 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]
30. Berg, H.; Steinsbekk, A. Is individual practice in an immersive and interactive virtual reality application non-inferior to practicing with traditional equipment in learning systematic clinical observation? A randomized controlled trial. *BMC Med. Educ.* **2020**, *20*, 123. [CrossRef]
31. Berg, H.; Steinsbekk, A. The effect of self-practicing systematic clinical observations in a multiplayer, immersive, interactive virtual reality application versus physical equipment: A randomized controlled trial. *Adv. Health Sci. Educ.* **2021**, *26*, 667–682. [CrossRef]
32. 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]
33. Bliss, D.Z.; Becker, A.J.; Gurvich, O.V.; Bradley, C.S.; Olson, E.T.; Steffes, M.T.; Flaten, C.; Jameson, S.; Condon, J.P. Projected Augmented Reality (P-AR) for Enhancing Nursing Education about Pressure Injury: A Pilot Evaluation Study. *J. Wound Ostomy Cont. Nurs. Off. Publ. Wound Ostomy Cont. Nurses Soc.* **2022**, *49*, 128–136. [CrossRef]
34. 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]
35. Botha, B.S.; De 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]
36. Breitkreuz, K.R.; Kardong-Edgren, S.; Gilbert, G.E.; DeBlieck, 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]
37. Brown, T.; Hall, S.; Schmaltz, R.; McBride, J.; Hamilton, J. Reimagining nursing education through virtual reality. *Teach. Learn. Nurs.* **2023**, *18*, e273. [CrossRef]
38. 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]
39. Burmester, K.A.; Ahluwalia, J.P.; Ploutz-Snyder, R.J.; Strobbe, S. Interactive Computer Simulation for Adolescent Screening, Brief Intervention, and Referral to Treatment (SBIRT) for Substance Use in an Undergraduate Nursing Program. *J. Pediatr. Nurs.* **2019**, *49*, 31–36. [CrossRef] [PubMed]

40. Cadet, M.J. Application of game-based online learning platform: Kahoot a formative evaluation tool to assess learning. *Teach. Learn. Nurs.* **2023**, *18*, 419–422. [CrossRef]
41. 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]
42. 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]
43. Campbell, D.; Lugger, S.; Sigler, G.S.; Turkelson, C. Increasing awareness, sensitivity, and empathy for Alzheimer's dementia patients using simulation. *Nurse Educ. Today* **2021**, *98*, 104764. [CrossRef]
44. 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]
45. Castro, M.J.; López, M.; Cao, M.J.; Fernández-Castro, M.; García, S.; Frutos, M.; Jiménez, J.M. Impact of educational games on academic outcomes of students in the Degree in Nursing. *PLoS ONE* **2019**, *14*, e0220388. [CrossRef] [PubMed]
46. 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]
47. Chae, D.; Kim, J.; Kim, K.; Ryu, J.; Asami, K.; Doorenbos, A.Z. An Immersive Virtual Reality Simulation for Cross-Cultural Communication Skills: Development and Feasibility. *Clin. Simul. Nurs.* **2023**, *77*, 13–22. [CrossRef]
48. Chan, H.Y.; Chang, H.C.; Huang, T.W. Virtual reality teaching in chemotherapy administration: Randomised controlled trial. *J. Clin. Nurs.* **2021**, *30*, 1874–1883. [CrossRef] [PubMed]
49. 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]
50. Chang, C.Y.; Panjaburee, P.; Chang, S.C. Effects of integrating maternity VR-based situated learning into professional training on students' learning performances. *Interact. Learn. Environ.* **2022**, 1–15. [CrossRef]
51. 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]
52. Chang, H.Y.; Chen, C.H.; Liu, C.W. The effect of a virtual simulation-based educational application on nursing students' belief and self-efficacy in communicating with patients about complementary and alternative medicine. *Nurse Educ. Today* **2022**, *114*, 105394. [CrossRef]
53. Chang, H.Y.; Wu, H.F.; Chang, Y.C.; Tseng, Y.S.; Wang, Y.C. The effects of a virtual simulation-based, mobile technology application on nursing students' learning achievement and cognitive load: Randomized controlled trial. *Int. J. Nurs. Stud.* **2021**, *120*, 103948. [CrossRef]
54. Chang, Y.M.; Lai, C. Exploring the experiences of nursing students in using immersive virtual reality to learn nursing skills. *Nurse Educ. Today* **2021**, *97*, 104670. [CrossRef]
55. Chao, Y.C.; Hu, S.H.; Chiu, H.Y.; Huang, P.H.; Tsai, H.T.; Chuang, Y.H. The effects of an immersive 3d interactive video program on improving student nurses' nursing skill competence: A randomized controlled trial study. *Nurse Educ. Today* **2021**, *103*, 104979. [CrossRef] [PubMed]
56. Chen, P.J.; Liou, W.K. Development and Application of AR-Based Assessment System for Infant Airway Obstruction First Aid Training. *Children* **2022**, *9*, 1622. [CrossRef] [PubMed]
57. Chen, P.J.; Liou, W.K. The effects of an augmented reality application developed for paediatric first aid training on the knowledge and skill levels of nursing students: An experimental controlled study. *Nurse Educ. Today* **2023**, *120*, 105629. [CrossRef] [PubMed]
58. Chevalier, S.; Paquay, M.; Goffoy, J.; Servotte, J.C.; Stipulante, S.; Ghuysen, A. Impact of virtual reality on performance among undergraduate healthcare professionals: A cross-sectional study. *Int. J. Healthc. Manag.* **2023**, 1–10. [CrossRef]
59. Chircop, A.; Cobbett, S. Gett'n on the bus: Evaluation of Sentinel City®3.0 virtual simulation in community/population health clinical placement. *Int. J. Nurs. Educ. Scholarsh.* **2020**, *17*, 20190109. [CrossRef] [PubMed]
60. Choi HLee, U.; Jeon, Y.S.; Kim, C. Efficacy of the Computer Simulation-Based, Interactive Communication Education Program for Nursing Students. *Nurse Educ. Today* **2020**, *91*, 104467. [CrossRef] [PubMed]
61. Choi, H.; Lee, U.; Gwon, T. Development of a Computer Simulation-based, Interactive, Communication Education Program for Nursing Students. *Clin. Simul. Nurs.* **2021**, *56*, 1–9. [CrossRef]
62. Choi, K.S. Virtual reality simulation for learning wound dressing: Acceptance and usability. *Clin. Simul. Nurs.* **2022**, *68*, 49–57. [CrossRef]
63. 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]
64. Chun, S.W.; Seo, J.H.; Kicklighter, C.; Wells-Beede, E.; Greene, J.; Arguello, T. Exploration of Visuo-haptic Interactions to Support Learning Leopold's Maneuvers Process in Virtual Reality. In Proceedings of the SIGGRAPH Asia 2021 XR (SA '21 XR), Tokyo, Japan, 14–17 December 2021; Association for Computing Machinery: New York, NY, USA, 2021; pp. 1–3. [CrossRef]
65. Cieslowski, B.; Haas, T.; Oh, K.M.; Chang, K.; Oetjen, C.A. The Development and Pilot Testing of Immersive Virtual Reality Simulation Training for Prelicensure Nursing Students: A QuasiExperimental Study. *Clin. Simul. Nurs.* **2023**, *77*, 6–12. [CrossRef]

66. Collier, R.; Darling, R.; Sprague, L.M.; Murphy, J. The Development and Feasibility of an Empathy Virtual Reality Scenario in Healthcare Education. *Comput. Inform. Nurs. CIN* **2023**, *41*, 759–764. [CrossRef] [PubMed]
67. Coveney, K.; Somanadhan, S.; Nicholson, E.; Piga, S.; Pizziconi, V.; D'Elpidio, G.; Gazzeloni, A. First year nursing students' evaluation of Kahoot! to facilitate learning and testing knowledge. A pilot study in Ireland and Italy. *Teach. Learn. Nurs.* **2022**, *17*, 163–168. [CrossRef]
68. 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] [PubMed]
69. da Silva, G.C.; da 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*; Ahram, T., Falcão, C., Eds.; Advances in Intelligent Systems and Computing 2019; Springer: Cham, Switzerland, 2019; Volume 794. [CrossRef]
70. Dang, B.K.; O'Leary-Kelley, C.; Palicte, J.S.; Badheka, S.; Vuppalapati, C. Comparing Virtual Reality Telepresence and Traditional Simulation Methods: A Pilot Study. *Nurs. Educ. Perspect.* **2020**, *41*, 119–121. [CrossRef] [PubMed]
71. de Beer, E.E.H.M.; van Os-Medendorp, H.H.; Groeneveld, S.S.W.M.; Jukema, J.S.J.S. Perceived contribution of a hybrid serious game to the development of collaborative problem solving among undergraduate nursing students: A mixed method design. *Nurse Educ. Pract.* **2023**, *73*, 103794. [CrossRef] [PubMed]
72. Díaz, D.A.; Anderson, M.; Hill, P.P.; Quelly, S.B.; Clark, K.; Lynn, M. Comparison of Clinical Options: High-Fidelity Manikin-Based and Virtual Simulation. *Nurse Educ.* **2021**, *46*, 149–153. [CrossRef] [PubMed]
73. Donnelly, F.; McLiesh, P.; Bessell, S.-A.; Walsh, A. Preparing students for clinical placement using 360-video. *Clin. Simul. Nurs.* **2023**, *77*, 34–41. [CrossRef]
74. Dubovi, I. Cognitive and emotional engagement while learning with VR: The perspective of multimodal methodology. *Comput. Educ.* **2022**, *183*, 104495. [CrossRef]
75. Dubovi, I. Learning with virtual reality simulations: Direct versus vicarious instructional experience. *Interact. Learn. Environ.* **2023**, *31*, 6627–6639. [CrossRef]
76. 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]
77. Egilsdottir, H.Ö.; Heyn, L.G.; Brembo, E.A.; Byermoen, K.R.; Moen, A.; Eide, H. Configuration of Mobile Learning Tools to Support Basic Physical Assessment in Nursing Education: Longitudinal Participatory Design Approach. *JMIR Mhealth Uhealth* **2021**, *9*, e22633. [CrossRef]
78. EL Machtani EL Idrissi, W.; Chemsi, G.; EL Kababi, K.; 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]
79. Elzeky, M.E.H.; Elhabashy, H.M.M.; Ali, W.G.M.; Allam, S.M.E. Effect of gamified flipped classroom on improving nursing students' skills competency and learning motivation: A randomized controlled trial. *BMC Nurs.* **2022**, *21*, 316. [CrossRef] [PubMed]
80. 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]
81. Fairén, M.; Moyés, J.; Insa, E. VR4Health: Personalized teaching and learning anatomy using VR. *J. Med. Syst.* **2020**, *44*, 94. [CrossRef] [PubMed]
82. 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]
83. Flo, J.; Byermoen, K.; Egilsdottir, H.; Eide, H.; Heyn, L. Nursing students' experiences of virtual simulation when using a video conferencing system—A mixed methods study. *Int. J. Nurs. Educ. Scholarsh.* **2021**, *18*, 20210056. [CrossRef]
84. Fontenot, J.; Hebert, M.; Lin, H.C.; Kulshreshth, A.K. Examining the Perceptions among Undergraduate Nursing Students Using Virtual Reality in a Community Course: A Mixed-Methods Explanatory Study. *J. Community Health Nurs.* **2024**, *41*, 145–155. [CrossRef] [PubMed]
85. García-Pazo, P.; Pol-Castañeda, S.; Moreno-Mulet, C.; Pomar-Forteza, A.; Carrero-Planells, A. Virtual reality and critical care education in nursing: A cross-sectional study. *Nurse Educ. Today* **2023**, *131*, 105971. [CrossRef] [PubMed]
86. 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]
87. Gazzelloni, A.; Sguanci, M.; Piredda, M.; Calandrella, C.; Tieri, G.; Piga, S.; Pizziconi, V.; D'Elpidio, G.; Alvaro, R.; De Marinis, M.G. 360-Degree Video for Cardiopulmonary Resuscitation (CPR) Knowledge: Preliminary Data of a Randomized Controlled Trial. In *Methodologies and Intelligent Systems for Technology Enhanced Learning, Workshops-13th International Conference. MIS4TEL 2023*; Kubincová, Z., Caruso, F., Kim, T., Ivanova, M., Lancia, L., Pellegrino, M.A., Eds.; Lecture Notes in Networks and Systems 2023; Springer: Cham, Switzerland, 2023; Volume 769. [CrossRef]
88. Georg, C.; Welin, E.; Jirwe, M.; Karlgren, K.; Ulfvarson, J. Psychometric properties of the virtual patient version of the Lasater Clinical Judgment Rubric. *Nurse Educ. Pract.* **2019**, *38*, 14–20. [CrossRef] [PubMed]
89. 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]

90. Giordano, N.A.; Febres-Cordero, S.; Baker, H.; Pfeiffer, K.M.; Walsh, L.M.; Gish, A.; Axson, S.A. Opioid-involved overdose trainings delivered using remote learning modalities. *Nurs. Open* **2023**, *10*, 4132–4136. [CrossRef] [PubMed]
91. Giordano, N.A.; Whitney, C.E.; Axson, S.A.; Cassidy, K.; Rosado, E.; Hoyt-Brennan, A.M. A pilot study to compare virtual reality to hybrid simulation for opioid-related overdose and naloxone training. *Nurse Educ. Today* **2020**, *88*, 104365. [CrossRef] [PubMed]
92. Girão, A.L.A.; Dos Santos, M.N.O.; Chaves, E.M.C.; Gomes, E.B.; de 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] [PubMed]
93. Goldsworthy, S.; Muir, N.; Baron, S.; Button, D.; Goodhand, K.; Hunter, S.; McNeill, L.; Perez, G.; McParland, T.; Fasken, L.; et al. The impact of virtual simulation on the recognition and response to the rapidly deteriorating patient among undergraduate nursing students. *Nurse Educ. Today* **2022**, *110*, 105264. [CrossRef] [PubMed]
94. Gonzalez, L.; Daher, S.; Welch, G. Neurological Assessment Using a Physical-Virtual Patient (PVP). *Simul. Gaming* **2020**, *51*, 802–818. [CrossRef]
95. Grech, J.; Grech, J. Nursing students' evaluation of a gamified public health educational webinar: A comparative pilot study. *Nurs. Open* **2021**, *8*, 1812–1821. [CrossRef]
96. 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] [PubMed]
97. 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]
98. Hall, D. Integrating Immersive Virtual Reality Simulation in Prelicensure Nursing Education. *Nurse Educ.* **2023**, *48*, E170–E171. [CrossRef]
99. Han, L.; Cao, Q.; Xie, T.; Chen, X.; Liu, Y.; Bai, J. Exploring the experience of nursing undergraduates in using gamification teaching mode based on the flow theory in nursing research: A qualitative study. *Nurse Educ. Today* **2021**, *107*, 105158. [CrossRef] [PubMed]
100. Hannans, J. Integrating LGBTQI+ Content in Nursing Education Using Immersive Virtual Reality: Embodying Eden. *Nurs. Educ. Perspect.* **2023**, *44*, 321–322. [CrossRef] [PubMed]
101. Hannans, J.A.; Nevins, C.M.; Jordan, K. See it, hear it, feel it: Embodying a patient experience through immersive virtual reality. *Inf. Learn. Sci.* **2021**, *122*, 565–583. [CrossRef]
102. Hanson, J.; Andersen, P.; Dunn, P.K. Effectiveness of three-dimensional visualisation on undergraduate nursing and midwifery students' knowledge and achievement in pharmacology: A mixed methods study. *Nurse Educ. Today* **2019**, *81*, 19–25. [CrossRef] [PubMed]
103. Hanson, J.; Andersen, P.; Dunn, P.K. The effects of a virtual learning environment compared with an individual handheld device on pharmacology knowledge acquisition, satisfaction and comfort ratings. *Nurse Educ. Today* **2020**, *92*, 104518. [CrossRef] [PubMed]
104. 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] [PubMed]
105. Hardie, P.; Darley, A.; Carroll, L.; Redmond, C.; Campbell, A.; Jarvis, S. Nursing & Midwifery students' experience of immersive virtual reality storytelling: An evaluative study. *BMC Nurs.* **2020**, *19*, 78. [CrossRef]
106. 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] [PubMed]
107. Helle, N.; Vikman, M.D.; Dahl-Michelsen, T.; Lie, S.S. Health Care and Social Work Students' Experiences With a Virtual Reality Simulation Learning Activity: Qualitative Study. *JMIR Med. Educ.* **2023**, *9*, e49372. [CrossRef]
108. Herbert, V.M.; Perry, R.J.; LeBlanc, C.A.; Haase, K.N.; Corey, R.R.; Giudice, N.A.; Howell, C. Developing a Smartphone App With Augmented Reality to Support Virtual Learning of Nursing Students on Heart Failure. *Clin. Simul. Nurs.* **2021**, *54*, 77–85. [CrossRef]
109. Hester, L.; Reed, B.; Bohannan, W.; Box, M.; Wells, M.; O'Neal, B. Using an educational mobile application to teach students to take vital signs. *Nurse Educ. Today* **2021**, *107*, 105154. [CrossRef] [PubMed]
110. Ho, C.J.; Chiu, W.H.; Li, M.Z.; Huang, C.Y.; Cheng, S.F. The effectiveness of the iLearning application on chest tube care education in nursing students. *Nurse Educ. Today* **2021**, *101*, 104870. [CrossRef] [PubMed]
111. Hoffman, J.L.; Argeros, G. Using Virtual Simulation to Teach Community Health Nursing Students About Public Health Nursing. *J. Community Health Nurs.* **2021**, *38*, 244–252. [CrossRef] [PubMed]
112. 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] [PubMed]
113. 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] [PubMed]
114. 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]

115. Ignacio, J.; Chen, H.C. The use of web-based classroom gaming to facilitate cognitive integration in undergraduate nursing students: A mixed methods study. *Nurse Educ. Pract.* **2020**, *46*, 102820. [CrossRef] [PubMed]
116. Inangil, D.; Dincer, B.; Kabuk, A. Effectiveness of the Use of Animation and Gamification in Online Distance Education During Pandemic. *Comput. Inform. Nurs. CIN* **2022**, *40*, 335–340. [CrossRef] [PubMed]
117. 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. ASC 2019*; Naweed, A., Bowditch, L., Sprick, C., Eds.; Communications in Computer and Information Science 2019; Springer: Singapore, 2019; Volume 1067. [CrossRef]
118. İsmailoğlu, E.G.; Orkun, N.; Eşer, İ.; Zaybak, A. Comparison of the effectiveness of the virtual simulator and video-assisted teaching on intravenous catheter insertion skills and self-confidence: A quasi-experimental study. *Nurse Educ. Today* **2020**, *95*, 104596. [CrossRef]
119. Jeong, Y.; Lee, H.; Han, J.W. Development and evaluation of virtual reality simulation education based on coronavirus disease 2019 scenario for nursing students: A pilot study. *Nurs. Open* **2022**, *9*, 1066–1076. [CrossRef]
120. Johnsen, H.M.; Briseid, H.S.; Brodtkorb, K.; Slettebø, Å.; Fossum, M. Nursing students' perceptions of combining hands-on simulation with simulated patients and a serious game in preparing for clinical placement in home healthcare: A qualitative study. *Nurse Educ. Today* **2021**, *97*, 104675. [CrossRef]
121. Jung, A.-R.; Park, E.-A. The Effectiveness of Learning to Use HMD-Based VR Technologies on Nursing Students: Chemoport Insertion Surgery. *Int. J. Environ. Res. Public. Health* **2022**, *19*, 4823. [CrossRef]
122. Kang, K.A.; Kim, S.J.; Lee, M.N.; Kim, M.; Kim, S. Comparison of Learning Effects of Virtual Reality Simulation on Nursing Students Caring for Children with Asthma. *Int. J. Environ. Res. Public. Health* **2020**, *17*, 8417. [CrossRef] [PubMed]
123. Kardong-Edgren, S.; Breitkreuz, 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]
124. 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]
125. 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]
126. Khraisat, A.M.S.; Hapidin, H.; Ahmad, N.S.H.N.; Yusoff, M.D.M.; Nurumal, M.S.; Pardi, K.W. How to teach intramuscular injection through virtual learning environment in covid-19 pandemic time for nursing students. *Indian J. Forensic Med. Toxicol.* **2020**, *14*, 697–704. [CrossRef]
127. Kiegaldie, D.; Shaw, L. Virtual reality simulation for nursing education: Effectiveness and feasibility. *BMC Nurs.* **2023**, *22*, 488. [CrossRef] [PubMed]
128. Killam, L.A.; Luctkar-Flude, M. Virtual Simulations to Replace Clinical Hours in a Family Assessment Course: Development Using H5P, Gamification, and Student Co-Creation. *Clin. Simul. Nurs.* **2021**, *57*, 59–65. [CrossRef]
129. Killam, L.A.; Timmermans, K.E.; Shapiro, S.J. Motivation and Engagement of Nursing Students in 2 Gamified Courses: A Mixed-Methods Study. *Nurse Educ.* **2021**, *46*, E173–E178. [CrossRef]
130. Kim, H.; Kim, B. Effects of Situation-Based Flipped Learning and Gamification as Combined Methodologies in Psychiatric Nursing Education: A Quasi-Experimental Study. *Healthcare* **2022**, *10*, 644. [CrossRef] [PubMed]
131. Kim, H.Y.; Chun, J. Effects of a Patient Experience-Based Virtual Reality Blended Learning Program on Nursing Students. *Comput. Inform. Nurs. CIN* **2022**, *40*, 438–446. [CrossRef] [PubMed]
132. Kim, H.Y.; Lee, J.H.; Lee, E.H. Virtual Experience of Perioperative Patients: Walking in the Patients' Shoes Using Virtual Reality and Blended Learning. *Int. J. Environ. Res. Public Health* **2021**, *18*, 6457. [CrossRef] [PubMed]
133. Kim, S.K.; Lee, Y.; Go, Y. Constructing a Mixed Simulation With 360° Virtual Reality and a High-Fidelity Simulator: Usability and Feasibility Assessment. *Comput. Inform. Nurs. CIN* **2023**, *41*, 569–577. [CrossRef] [PubMed]
134. Kim, S.K.; Lee, Y.; Yoon, H.; Choi, J. Adaptation of Extended Reality Smart Glasses for Core Nursing Skill Training Among Undergraduate Nursing Students: Usability and Feasibility Study. *J. Med. Internet Res.* **2021**, *23*, e24313. [CrossRef] [PubMed]
135. 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]
136. 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]
137. Kor, P.P.K.; Liu, J.Y.W.; Kwan, R.Y.C. Exploring nursing students' learning experiences and attitudes toward older persons in a gerontological nursing course using self-regulated online enquiry-based learning during the COVID-19 pandemic: A mixed-methods study. *Nurse Educ. Today* **2022**, *111*, 105301. [CrossRef]
138. Kurt, Y.; Öztürk, H. The effect of mobile augmented reality application developed for injections on the knowledge and skill levels of nursing students: An experimental controlled study. *Nurse Educ. Today* **2021**, *103*, 104955. [CrossRef]
139. 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]

140. 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] [PubMed]
141. Lee, E.; Baek, G. Development and Effects of a Virtual Reality Simulation Nursing Education Program Combined With Clinical Practice Based on an Information Processing Model. *Comput. Inform. Nurs. CIN* **2023**, *41*, 1016–1025. [CrossRef] [PubMed]
142. Lee, E.; Baek, G.; Hwang, Y. Effectiveness of the Patient's Severity Classification Competency Promotion Virtual Reality Program of Nursing Students during the COVID-19 Pandemic Period. *Healthcare* **2023**, *11*, 1122. [CrossRef]
143. Lee, H.; Kim, C.; Kim, H.; Kim, J.; Kang, M. Improving Active Collaborative Clinical Learning Through a Mobile Application for Undergraduate Nursing Students. *Comput. Inform. Nurs. CIN* **2023**, *41*, 309–315. [CrossRef] [PubMed]
144. Lee, H.; Han, J.W. Development and evaluation of a virtual reality mechanical ventilation education program for nursing students. *BMC Med. Educ.* **2022**, *22*, 775. [CrossRef]
145. Lee, H.; Yi, Y.; Moon, W.; Yeo, J.Y. Exploring the potential use of the metaverse in nurse education through a mock trial. *Nurse Educ. Today* **2023**, *131*, 105974. [CrossRef] [PubMed]
146. Lee, J.J.; Tsang, V.W.Y.; Chan, M.M.K.; O'Connor, S.; Lokmic-Tomkins, Z.; Ye, F.; Kwok, J.Y.Y.; Ho, M.H. Virtual reality simulation-enhanced blood transfusion education for undergraduate nursing students: A randomised controlled trial. *Nurse Educ. Today* **2023**, *129*, 105903. [CrossRef]
147. Lee, J.S. Implementation and Evaluation of a Virtual Reality Simulation: Intravenous Injection Training System. *Int. J. Environ. Res. Public Health* **2022**, *19*, 5439. [CrossRef]
148. Lee, J.S.; Son, H.K. Evaluation of a Virtual Reality Simulation to Improve Problem-Based Learning for Neurologic Examination in Nursing Students. *Iran. J. Public Health* **2023**, *52*, 2128–2137. [CrossRef]
149. Lee, U.; Choi, H.; Jeon, Y. Nursing Students' Experiences with Computer Simulation-Based Communication Education. *Int. J. Environ. Res. Public Health* **2021**, *18*, 3108. [CrossRef]
150. Lee, Y.; Kim, S.K.; Eom, M.R. Usability of mental illness simulation involving scenarios with patients with schizophrenia via immersive virtual reality: A mixed methods study. *PLoS ONE* **2020**, *15*, e0238437. [CrossRef] [PubMed]
151. Lee, Y.; Suh, M.; Jung, T. Effect of Virtual Reality Based Nursing Skills on the Performance Ability, Performance Confidence, and Practice Satisfaction of Nursing College Students. In *Extended Reality and Metaverse. XR 2022*; Jung, T., Dieck, M.C., Correia Loureiro, S.M., Eds.; Springer Proceedings in Business and Economics 2023; Springer: Cham, Switzerland, 2023. [CrossRef]
152. 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]
153. Liang, C.; Start, C.; Boley, H.; Kamat, V.R.; Menassa, C.C.; Aebersold, M.L. Enhancing stroke assessment simulation experience in clinical training using augmented reality. *Virtual Real.* **2021**, *25*, 575–584. [CrossRef]
154. Liaw, S.Y.; Ooi, S.W.; Rusli, K.D.B.; Lau, T.C.; Tam, W.W.S.; Chua, W.L. Nurse-Physician Communication Team Training in Virtual Reality Versus Live Simulations: Randomized Controlled Trial on Team Communication and Teamwork Attitudes. *J. Med. Internet Res.* **2020**, *22*, e17279. [CrossRef] [PubMed]
155. Liaw, S.Y.; Ooi, S.L.; Mildon, R.; Ang, E.N.K.; Lau, T.C.; Chua, W.L. Translation of an evidence-based virtual reality simulation-based interprofessional education into health education curriculums: An implementation science method. *Nurse Educ. Today* **2022**, *110*, 105262. [CrossRef] [PubMed]
156. Liaw, S.Y.; Soh, S.L.; Tan, K.K.; Wu, L.T.; Yap, J.; Chow, Y.L.; Lau, T.C.; Lim, W.S.; Tan, S.C.; Choo, H.; et al. Design and evaluation of a 3D virtual environment for collaborative learning in interprofessional team care delivery. *Nurse Educ. Today* **2019**, *81*, 64–71. [CrossRef] [PubMed]
157. Liaw, S.Y.; Sutini; Chua, W.L.; Tan, J.Z.; Levett-Jones, T.; Ashokka, B.; Te Pan, T.L.; Lau, S.T.; Ignacio, J. Desktop Virtual Reality Versus Face-to-Face Simulation for Team-Training on Stress Levels and Performance in Clinical Deterioration: A Randomised Controlled Trial. *J. Gen. Intern. Med.* **2023**, *38*, 67–73. [CrossRef]
158. Liaw, S.Y.; Tan, J.Z.; Bin Rusli, K.D.; Ratan, R.; Zhou, W.; Lim, S.; Lau, T.C.; Seah, B.; Chua, W.L. Artificial Intelligence Versus Human-Controlled Doctor in Virtual Reality Simulation for Sepsis Team Training: Randomized Controlled Study. *J. Med. Internet Res.* **2023**, *25*, e47748. [CrossRef] [PubMed]
159. Liaw, S.Y.; Tan, J.Z.; Lim, S.; Zhou, W.; Yap, J.; Ratan, R.; Ooi, S.L.; Wong, S.J.; Seah, B.; Chua, W.L. Artificial intelligence in virtual reality simulation for interprofessional communication training: Mixed method study. *Nurse Educ. Today* **2023**, *122*, 105718. [CrossRef]
160. Liaw, S.Y.; Wu, L.T.; Soh, S.L.; Ringsted, C.; Lau, T.C.; Lim, W.S. Virtual Reality Simulation in Interprofessional Round Training for Health Care Students: A Qualitative Evaluation Study. *Clin. Simul. Nurs.* **2020**, *45*, 42–46. [CrossRef]
161. 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] [PubMed]
162. Liu, W. Virtual Simulation in Undergraduate Nursing Education: Effects on Students' Correct Recognition of and Causative Beliefs About Mental Disorders. *Comput. Inform. Nurs. CIN* **2021**, *39*, 616–626. [CrossRef]
163. Liu, Y.; Butzlaff, A. Where's the germs? The effects of using virtual reality on nursing students' hospital infection prevention during the COVID-19 pandemic. *J. Comput. Assist. Learn.* **2021**, *37*, 1622–1628. [CrossRef] [PubMed]

164. Lo, Y.T.; Yang, C.C.; Yeh, T.F.; Tu, H.Y.; Chang, Y.C. Effectiveness of immersive virtual reality training in nasogastric tube feeding education: A randomized controlled trial. *Nurse Educ. Today* **2022**, *119*, 105601. [CrossRef] [PubMed]
165. 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]
166. 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. *Cyberpsychology Behav. Soc. Netw.* **2021**, *24*, 750–755. [CrossRef] [PubMed]
167. Mackavey, C.; Cron, S. Innovative strategies: Increased engagement and synthesis in online advanced practice nursing education. *Nurse Educ. Today* **2019**, *76*, 85–88. [CrossRef] [PubMed]
168. Mahaffey, A.L. "N.A.M.E." FUN! Emojis may illustrate structure-function relationships of neurotransmitters to health professions students. *Adv. Physiol. Educ.* **2021**, *45*, 895–901. [CrossRef]
169. 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] [PubMed]
170. 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]
171. 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] [PubMed]
172. 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]
173. 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]
174. Matsuura, J.; Kunii, T.; Noborio, H.; Watanabe, K.; Onishi, K.; Nakamura, H. Development of a VR/HMD System for Simulating Several Scenarios of Post-Operative Delirium. In *Human-Computer Interaction. Interaction Techniques and Novel Applications. HCII 2021*; Kurosu, M., Ed.; Lecture Notes in Computer Science 2021; Springer: Cham, Switzerland, 2021; Volume 12763. [CrossRef]
175. Matsuura, J.; Kunii, T.; Teranishi, K.; Tatsuana, H.; Noborio, H. Changes in the Perception of Postoperative Delirium before and after a Simulated Experience of Postoperative Delirium in Nursing Students. In Proceedings of the 6th International Conference on Intelligent Informatics and Biomedical Sciences (ICIIBMS), Oita, Japan, 25–27 November 2021; pp. 101–106. [CrossRef]
176. Mayor Silva, L.I.; Caballero de la Calle, R.; Cuevas-Budhart, M.A.; Martin Martin, J.O.; Blanco Rodriguez, J.M.; Gómez Del Pulgar García Madrid, M. Development of Communication Skills Through Virtual Reality on Nursing School Students: Clinical Trial. *Comput. Inform. Nurs. CIN* **2023**, *41*, 24–30. [CrossRef] [PubMed]
177. Hsu, M.H.K.; U, S.H.; Ye, Q.H. The Application of Aged Simulation and Virtual Reality in Gerontological Nursing Education. In Proceedings of the 7th International Conference on Education and Multimedia Technology (ICEMT 2023), Tokyo, Japan, 29–31 August 2023; ACM: New York, NY, USA, 2023. [CrossRef]
178. Menon, S.S.; Holland, C.; Farra, S.; Wischgoll, T.; Stuber, M. Augmented Reality in Nursing Education—A Pilot Study. *Clin. Simul. Nurs.* **2022**, *65*, 57–61. [CrossRef]
179. 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.
180. Nakazawa, A.; Iwamoto, M.; Kurazume, R.; Nunoi, M.; Kobayashi, M.; Honda, M. Augmented reality-based affective training for improving care communication skill and empathy. *PLoS ONE* **2023**, *18*, e0288175. [CrossRef] [PubMed]
181. 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]
182. Navarro-Martínez, O.; Silva, J.; Ibáñez-del Valle, V. Performance of Nursing Students with a Graphic Novel and a Collaborative Quiz Competition: A Quasi-Experimental Study. *Educ. Sci.* **2023**, *13*, 681. [CrossRef]
183. Negreiros, F.D.D.S.; Flor, A.C.; Araújo, A.L.; Cestari, V.R.F.; Florêncio, R.S.; Moreira, T.R.; Araújo, S.T.; Silva, L.M.S.D.; Moreira, T.M.M. E-MunDiabetes: A Mobile Application for Nursing Students on Diabetes Education during the COVID-19 Pandemic. *Comput. Inform. Nurs. CIN* **2022**, *40*, 325–334. [CrossRef]
184. Negreiros, F.D.D.S.; Flor, A.C.; Cestari, V.R.F.; Florêncio, R.S.; Moreira, T.M.M. Effect of an app on students' knowledge about diabetes during the COVID-19 pandemic. Efeito de um aplicativo no conhecimento de estudantes sobre diabetes durante a pandemia da COVID-19. *Rev. Lat.-Am. Enferm.* **2022**, *30*, e3595. [CrossRef]
185. Neuhöfer, J.A.; Wöllenstein, T.; Hansen, S. Evolution of an Approach for Digital Learning and Training in Nursing. In *Advances in Human Factors in Training, Education, and Learning Sciences. AHFE 2021*; Nazir, S., Ahram, T.Z., Karwowski, W., Eds.; Lecture Notes in Networks and Systems 2021; Springer: Cham, Switzerland, 2021; Volume 269. [CrossRef]
186. Ng, S.C.; Lee, L.K.; Lui, A.K.F.; Wong, K.F.; Chan, W.Y.; Tam, H.H. Using immersive reality in training nursing students. *Int. J. Innov. Learn.* **2020**, *27*, 324–343. [CrossRef]

187. 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]
188. Novoseltseva, D.; Pons Lelardeux, C.; Jessel, N. Factors Affecting Success in a Digital Simulation Game for Nurse Training. In *Games and Learning Alliance. GALA 2020*; Marfisi-Schottman, I., Bellotti, F., Hamon, L., Klemke, R., Eds.; Lecture Notes in Computer Science 2020; Springer: Cham, Switzerland, 2020; Volume 12517. [CrossRef]
189. Nugraha, A.; Kusnadi, E.; Patimah, I.; Sitorus, P.M.; Al Maki, W.F. Development of Virtual Reality Head-Mounted Display: Teaching Infection Prevention and Control to Millennial Nursing Students. *Health Educ. Health Promot.* **2023**, *11*, 405–410.
190. 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.
191. Oh, J.W.; Kim, J.E. Effectiveness of a virtual reality application-based education programme on patient safety management for nursing students: A pre-test-post-test study. *Nurs. Open* **2023**, *10*, 7622–7630. [CrossRef]
192. 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] [PubMed]
193. 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] [PubMed]
194. Pardue, K.T.; Holt, K.; Dunbar, D.M.; Baugh, N. Exploring the Development of Nursing Clinical Judgment Among Students Using Virtual Reality Simulation. *Nurse Educ.* **2023**, *48*, 71–75. [CrossRef]
195. Park, L.J.; Ford, C.; Melling, A.C. Using virtual reality to teach nursing students communication skills when breaking bad news: A focus group exploration of participant experiences. *J. Appl. Learn. Teach.* **2023**, *6*, 17–26. [CrossRef]
196. Park, S.; Hur, H.K.; Chung, C. Learning effects of virtual versus high-fidelity simulations in nursing students: A crossover comparison. *BMC Nurs.* **2022**, *21*, 100. [CrossRef] [PubMed]
197. Park, S.; Yoon, H.G. Effect of Virtual-Reality Simulation of Indwelling Catheterization on Nursing Students' Skills, Confidence, and Satisfaction. *Clin. Simul. Nurs.* **2023**, *80*, 46–54. [CrossRef]
198. Park, S.N.; Hwang, H.Y.; Koo, H.Y. Development of a virtual reality program in South Korea for the measurement of vital signs in children: A methodological study. *Child. Health Nurs. Res.* **2023**, *29*, 137–148. [CrossRef]
199. Penalo, L.M. Effects of the Virtual Simulation Prebriefing-Debriefing Educational Strategy on Nursing Students' Self-Efficacy and Virtual Simulation Performance: A Quasi-Experimental Study. *Clin. Simul. Nurs.* **2023**, *82*, 101431. [CrossRef]
200. Plotzky, C.; Loessl, B.; Kuhnert, B.; Friedrich, N.; Kugler, C.; König, P.; Kunze, C. My hands are running away-learning a complex nursing skill via virtual reality simulation: A randomised mixed methods study. *BMC Nurs.* **2023**, *22*, 222. [CrossRef]
201. 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. ICL 2019*; Auer, M., Hortsch, H., Sethakul, P., Eds.; Advances in Intelligent Systems and Computing 2020; Springer: Cham, Switzerland, 2020; Volume 1134. [CrossRef]
202. Puah, S.H.; Goh, C.Y.; Chan, C.L.; Teoh, A.K.J.; Zhang, H.; Shen, Z.; Neo, L.P. Mobile device: A useful tool to teach inhaler devices to healthcare professionals. *BMC Med. Educ.* **2022**, *22*, 238. [CrossRef] [PubMed]
203. Quay, C.; Ramakrishnan, A. Innovative Use of Virtual Reality to Facilitate Empathy Toward Older Adults in Nursing Education. *Nurs. Educ. Perspect.* **2023**, *44*, 300–302. [CrossRef] [PubMed]
204. Quqandi, E.; Joy, M.S.; Rushton, M.; Drumm, I. Mobile Augmented Reality in Nursing Educational Environments. In Proceedings of the 10th Computer Science and Electronic Engineering (CEEC), Colchester, UK, 19–21 September 2018; pp. 266–269.
205. Rodríguez-Abad, C.; Martínez-Santos, A.E.; Fernández-de-la-Iglesia, J.D.; Rodríguez-González, R. Online (versus face-to-face) augmented reality experience on nursing students' leg ulcer competency: Two quasi-experimental studies. *Nurse Educ. Pract.* **2023**, *71*, 103715. [CrossRef] [PubMed]
206. Rodríguez-Abad, C.; Rodríguez-González, R.; Martínez-Santos, A.E.; Fernández-de-la-Iglesia, J.D. Effectiveness of augmented reality in learning about leg ulcer care: A quasi-experimental study in nursing students. *Nurse Educ. Today* **2022**, *119*, 105565. [CrossRef]
207. Rodriguez-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]
208. 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] [PubMed]
209. 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]
210. Roman, P.; Ruiz-Gonzalez, C.; Rodriguez-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]
211. Ropero-Padilla, C.; Rodriguez-Arrastia, M.; Martinez-Ortigosa, A.; Salas-Medina, P.; Folch Ayora, A.; Roman, P. A gameful blended-learning experience in nursing: A qualitative focus group study. *Nurse Educ. Today* **2021**, *106*, 105109. [CrossRef] [PubMed]

212. 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]
213. 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] [PubMed]
214. Rose, K.A.; Jenkins, S.D.; Astroth, K.S.; Woith, W.; Jarvill, M. Testing a Web-Based Intervention to Improve Awareness of Civility and Incivility in Baccalaureate Nursing Students. *Clin. Simul. Nurs.* **2020**, *48*, 46–54. [CrossRef]
215. Rosillo, N.; Montes, N. Escape Room Dual Mode Approach to Teach Maths during the COVID-19 Era. *Mathematics* **2021**, *9*, 2602. [CrossRef]
216. Rossler, K.L.; Sankaranarayanan, G.; Duvall, A. Acquisition of Fire Safety Knowledge and Skills with Virtual Reality Simulation. *Nurse Educ.* **2019**, *44*, 88–92. [CrossRef]
217. Rumsey, K.; Joy, S.; Leger, J.M. Evolving Approaches to Meet Clinical Hours for Undergraduate Nursing Students during COVID-19. *Int. J. Environ. Res. Public Health* **2023**, *20*, 5974. [CrossRef]
218. Rushton, M.A.; Drumm, I.A.; Campion, S.P.; O'Hare, J.J. The Use of Immersive and Virtual Reality Technologies to Enable Nursing Students to Experience Scenario-Based, Basic Life Support Training-Exploring the Impact on Confidence and Skills. *Comput. Inform. Nurs. CIN* **2020**, *38*, 281–293. [CrossRef] [PubMed]
219. Saab, M.M.; Landers, M.; Murphy, D.; O'Mahony, B.; Cooke, E.; O'Driscoll, M.; Hegarty, J. Nursing students' views of using virtual reality in healthcare: A qualitative study. *J. Clin. Nurs.* **2022**, *31*, 1228–1242. [CrossRef] [PubMed]
220. Saab, M.M.; McCarthy, M.; O'Mahony, B.; Cooke, E.; Hegarty, J.; Murphy, D.; Walshe, N.; Noonan, B. Virtual Reality Simulation in Nursing and Midwifery Education: A Usability Study. *Comput. Inform. Nurs. CIN* **2023**, *41*, 815–824. [CrossRef] [PubMed]
221. Sáiz-Manzanares, M.C.; Martin, C.F.; Alonso-Martínez, L.; Almeida, L.S. Usefulness of Digital Game-Based Learning in Nursing and Occupational Therapy Degrees: A Comparative Study at the University of Burgos. *Int. J. Environ. Res. Public Health* **2021**, *18*, 11757. [CrossRef] [PubMed]
222. Salem, A.M.; Mohamed, N.M.A.; Masadeh, A. The effectiveness of computer-based simulation on nursing students' electrocardiogram interpretation. *Teach. Learn. Nurs.* **2023**, *18*, e9–e12. [CrossRef]
223. Samosorn, A.B.; Gilbert, G.E.; Bauman, E.B.; Khine, J.; McGonigle, D. Teaching airway insertion skills to nursing faculty and students using virtual reality: A pilot study. *Clin. Simul. Nurs.* **2020**, *39*, 18–26. [CrossRef]
224. 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]
225. 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] [PubMed]
226. Seiler, R.; Lemcke, B.; Block, A. VR in nursing education: High-fidelity vs low-fidelity implementations. In Proceedings of the International Conferences on Applied Computing and WWW/Internet 2022, Lisbon, Portugal, 8–10 November 2022; Weghorn, H., Isaias, P., Eds.; IADIS Press: Lisbon, Portugal, 2022; pp. 87–94.
227. Seo, J.H.; Kicklighter, C.; Garcia, B.; Chun, S.W.; Wells-Beede, E. Work-in-Progress–Design and Evaluation of 360 VR Immersive Interactions in Nursing Education. In Proceedings of the 7th International Conference of the Immersive Learning Research Network (iLRN), Eureka, CA, USA, 17 May–10 June 2021; pp. 1–3. [CrossRef]
228. Seok-Young, H. The Effects of Blended Learning Using Virtual Reality Simulation in Pediatrics-adolescent Nursing Clinical Practice. *J. Curric. Teach.* **2023**, *12*, 356–365. [CrossRef]
229. Seok, Y.; Suh, E.E. Development of a Health Promotion Application on Cancer Survivorship as an Educational Content for Nursing Students. *Asian Nurs. Res.* **2022**, *16*, 52–62. [CrossRef]
230. Shah, M.; Gouveia, C.; Babcock, B. Undergraduate Nursing Students' Experiences and Perceptions of Self-Efficacy in Virtual Reality Simulations. In Proceedings of the 8th International Conference of the Immersive Learning Research Network (iLRN), Vienna, Austria, 30 May–4 June 2022; pp. 1–7. [CrossRef]
231. Shah, M.; Gouveia, C.; Barakat, S. Simulation learning system with virtual reality for supporting practice readiness in undergraduate nursing education. In *International Collaboration toward Educational Innovation for All: Overarching Research, Development, and Practices, International Society of the Learning Sciences (ISLS) Annual Meeting 2022, Hiroshima, Japan, 6–10 June 2022*; Oshima, J., Mochizuki, T., Hayashi, Y., Eds.; International Society of the Learning Sciences (ISLS): Buffalo, NY, USA, 2022; pp. 76–79.
232. Shah, M.; Siebert-Evenstone, A.; Eagan, B.; Holthaus, R. Modeling Educator Use of Virtual Reality Simulations in Nursing Education Using Epistemic Network Analysis. In Proceedings of the 7th International Conference of the Immersive Learning Research Network (iLRN), Eureka, CA, USA, 17 May–10 June 2021; pp. 1–8. [CrossRef]
233. Shah, M.; Siebert-Evenstone, A.; Moots, H.; Eagan, B. Quality and Safety Education for Nursing (QSEN) in Virtual Reality Simulations: A Quantitative Ethnographic Examination. In *Advances in Quantitative Ethnography. ICQE 2021*; Wasson, B., Zörgő, S., Eds.; Communications in Computer and Information Science 2022; Springer: Cham, Switzerland, 2022; Volume 1522. [CrossRef]
234. Shahmoradi, L.; Mehrabanfar, M.; Meibodi, S.A.E.; Navab, E.; Ardakani, H.M.; Yazdani, A.; Farzi, J. Training pain management to nursing students: Designing, implementing, and evaluating a mobile-based application. *J. Educ. Health Promot.* **2021**, *10*, 379. [CrossRef] [PubMed]

235. Shorey, S.; Ang, E.; Ng, E.D.; Yap, J.; Lau, L.S.T.; Chui, C.K. Communication skills training using virtual reality: A descriptive qualitative study. *Nurse Educ. Today* **2020**, *94*, 104592. [CrossRef]
236. Liao, S.; Tan, M.; Chong, M.; Xiong, W.; Wang, J.; Luo, B. The Use of Virtual Reality to Improve Disaster Preparedness Among Nursing Students: A Randomized Study. *J. Nurs. Educ.* **2022**, *61*, 93–96. [CrossRef]
237. Siah, R.C.J.; Xu, P.; Teh, C.L.; Kow, A.W.C. Evaluation of nursing students' efficacy, attitude, and confidence level in a perioperative setting using virtual-reality simulation. *Nurs. Forum* **2022**, *57*, 1249–1257. [CrossRef] [PubMed]
238. Singleton, H.; James, J.; Penfold, S.; Falconer, L.; Priego-Hernandez, J.; Holley, D.; Burden, D. Deteriorating Patient Training Using Nonimmersive Virtual Reality: A Descriptive Qualitative Study. *Comput. Inform. Nurs. CIN* **2021**, *39*, 675–681. [CrossRef] [PubMed]
239. Singleton, H.; James, J.; Holley, D.; Falconer, L.; Priego-Hernandez, J.; Beavis, J.; Burden, D.; Penfold, S. Effect of non-immersive virtual reality simulation on type 2 diabetes education for nursing students: A randomised controlled trial. *Clin. Simul. Nurs.* **2022**, *66*, 50–57. [CrossRef]
240. Smith, S.; Farra, S.L.; Hodgson, E. Evaluation of two simulation methods for teaching a disaster skill. *BMJ Simul. Technol. Enhanc. Learn.* **2021**, *7*, 92–96. [CrossRef] [PubMed]
241. Smith, S.; Maund, K.; Hilaire, T.; Gajendran, T.; Lyneham, J.; Geale, S. Enhancing discipline specific skills using a virtual environment built with gaming technology. *Int. J. Work-Integr. Learn.* **2020**, *21*, 193–209.
242. Son, Y.; Kang, H.S.; De Gagne, J.C. Nursing Students' Experience of Using HoloPatient during the Coronavirus Disease 2019 Pandemic: A Qualitative Descriptive Study. *Clin. Simul. Nurs.* **2023**, *80*, 9–16. [CrossRef] [PubMed]
243. Soojeong, Y.; Sunkyung, K.; Youngho, L. Learning by Doing: Evaluation of an Educational VR Application for the Care of Schizophrenic Patients. In Proceedings of the Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems (CHI EA '20), Honolulu, HI, USA, 25–30 April 2020; Association for Computing Machinery: New York, NY, USA, 2020; pp. 1–6. [CrossRef]
244. Sook, K.P.; Hyuk, J.K. Development and Evaluation of Virtual Reality-based Simulation Content for Nursing Students Regarding Emergency Triage. *J. Korean Acad. Fundam. Nurs.* **2023**, *30*, 292–301. [CrossRef]
245. Soyoof, 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]
246. Stuart, J.; Aul, K.; Bumbach, M.D.; Stephen, A.; Lok, B. Building a Handoff Communication Virtual Experience for Nursing Students Using Virtual Humans. *Comput. Inform. Nurs. CIN* **2021**, *39*, 1017–1026. [CrossRef] [PubMed]
247. Stuart, J.; Stephen, A.; Aul, K.; Bumbach, M.D.; Huffman, S.; Russo, B.; Lok, B. Using augmented reality filters to display time-based visual cues. Front. *Virtual Real.* **2023**, *4*, 1127000. [CrossRef]
248. Su, J.; Xiong, J.M.; Yan, F.X.; Tian, X.Y.; Chen, Y.Y.; Dou, C.X.; Yang, Q.H. Effects of a virtual simulation-based interprofessional education activity for rehabilitation nursing using shared resources: A quasi-experimental study. *Nurse Educ. Today* **2023**, *126*, 105832. [CrossRef] [PubMed]
249. 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] [PubMed]
250. Tacgin, Z. Immersive virtual reality as an action: Measuring approach and learning status of learners after planning myVOR. *Educ. Media Int.* **2020**, *57*, 353–371. [CrossRef]
251. Taçgın, Z. The perceived effectiveness regarding Immersive Virtual Reality learning environments changes by the prior knowledge of learners. *Educ. Inf. Technol.* **2020**, *25*, 2791–2809. [CrossRef]
252. 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] [PubMed]
253. Thompson, D.S.; Thompson, A.P.; McConnell, K. Nursing students' engagement and experiences with virtual reality in an undergraduate bioscience course. *Int. J. Nurs. Educ. Scholarsh.* **2020**, *17*, 20190081. [CrossRef]
254. Tinôco, J.D.S.; Cossi, M.S.; Fernandes, M.I.D.C.D.; Paiva, A.C.; Lopes, M.V.O.; Lira, A.L.B.C. Effect of educational intervention on clinical reasoning skills in nursing: A quasi-experimental study. *Nurse Educ. Today* **2021**, *105*, 105027. [CrossRef]
255. Tran, C.; Toth-Pal, E.; Ekblad, S.; Fors, U.; Salminen, H. A virtual patient model for students' interprofessional learning in primary healthcare. *PLoS ONE* **2020**, *15*, e0238797. [CrossRef] [PubMed]
256. Tsai, Y.C.; Lin, G.L.; Cheng, C.C. Work-in-Progress-Development of Immersive Nursing Skills Learning System and Evaluation of Learning Effectiveness. In Proceedings of the 7th International Conference of the Immersive Learning Research Network (iLRN), Eureka, CA, USA, 17 May–10 June 2021; pp. 1–3. [CrossRef]
257. Vanduhe, V.Z.; Hassan, H.F.; Oluwajana, D.; Nat, M.; Idowu, A.; Agbo, J.J.; Okunlola, L. Students' Evidential Increase in Learning Using Gamified Learning Environment. In Proceedings of the Future Technologies Conference (FTC) 2018. FTC 2018, Vancouver, BC, Canada, 15–16 November 2018; Arai, K., Bhatia, R., Kapoor, S., Eds.; Advances in Intelligent Systems and Computing 2019. Springer: Cham, Switzerland, 2019; Volume 880. [CrossRef]
258. Verkuyl, M.; Betts, L.; Sivaramalingam, S. Nursing Students' Perceptions Using an Interactive Digital Simulation Table: A Usability Study. *Simul. Gaming* **2019**, *50*, 202–213. [CrossRef]

259. Verkuyl, 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] [PubMed]
260. Verkuyl, 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]
261. 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] [PubMed]
262. Wang, C.Y.; Yin, T.; Ma, K.H.; Shyu, J.F.; Cheng, C.P.; Wang, Y.C.; Huang, Y.L.; Chiang, M.H. Enhancing anatomy education through cooperative learning: Harnessing virtual reality for effective gross anatomy learning. *J. Microbiol. Biol. Educ.* **2023**, *24*, e00100-23. [CrossRef] [PubMed]
263. Wang, W.; Sun, R.; Huang, L.; Swigart, V. Student Perceptions of Classic and Game-Based Online Student Response Systems. *Nurse Educ.* **2019**, *44*, E6–E9. [CrossRef] [PubMed]
264. Williams, D.; Stephen, L.A.; Causton, P. Teaching interprofessional competencies using virtual simulation: A descriptive exploratory research study. *Nurse Educ. Today* **2020**, *93*, 104535. [CrossRef] [PubMed]
265. 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]
266. Wu, J.G.; Miller, L.; Huang, Q.; Wang, M. Learning with Immersive Virtual Reality: An Exploratory Study of Chinese College Nursing Students. *RELC J.* **2023**, *54*, 697–713. [CrossRef]
267. Wu, M.L.; Chao, L.F.; Xiao, X. A pediatric seizure management virtual reality simulator for nursing students: A quasi-experimental design. *Nurse Educ. Today* **2022**, *119*, 105550. [CrossRef] [PubMed]
268. Wu, S.H.; Huang, C.C.; Huang, S.S.; Yang, Y.Y.; Liu, C.W.; Shulruf, B.; Chen, C.H. Effect of virtual reality training to decreases rates of of needlestick or sharp injuries in new-coming medical and nursing interns in Taiwan. *J. Educ. Eval. Health Prof.* **2020**, *17*, 1. [CrossRef] [PubMed]
269. Xiao, X.; Xiao, Y.; Dumlao, M.F. Evaluation of Gamification on Surgical Nursing Course using Immersive Virtual Reality: A comparative study. In Proceedings of the 2023 4th International Symposium on Artificial Intelligence for Medicine Science (ISAIMS '23), Chengdu, China, 20–22 October 2023; Association for Computing Machinery: New York, NY, USA, 2023; pp. 614–620. [CrossRef]
270. 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] [PubMed]
271. Yang, S.Y.; Oh, Y.H. The effects of neonatal resuscitation gamification program using immersive virtual reality: A quasi-experimental study. *Nurse Educ. Today* **2022**, *117*, 105464. [CrossRef] [PubMed]
272. Yeh, C.H.; Huang, H.M.; Kuo, C.L.; Huang, C.Y.; Cheng, S.F. Effectiveness of e-STORY App in clinical reasoning competency and self-directed learning among students in associate nursing program: A quasi experimental study. *Nurse Educ. Pract.* **2022**, *64*, 103456. [CrossRef] [PubMed]
273. Yeo, J.-Y.; Jang, M.S. Nursing students' self-directed learning experiences in web-based virtual simulation: A qualitative study. *Jpn. J. Nurs. Sci.* **2023**, *20*, e12514. [CrossRef] [PubMed]
274. Yildiz, H.; Demiray, A. Virtual reality in nursing education 3D intravenous catheterization E-learning: A randomized controlled trial. *Contemp. Nurse* **2022**, *58*, 125–137. [CrossRef] [PubMed]
275. Yu, M.; Mann, J.S. Development of Virtual Reality Simulation Program for High-risk Neonatal Infection Control Education. *Clin. Simul. Nurs.* **2021**, *50*, 19–26. [CrossRef]
276. Yu, M.; Yang, M.; Ku, B.; Mann, J.S. Effects of Virtual Reality Simulation Program Regarding High-risk Neonatal Infection Control on Nursing Students. *Asian Nurs. Res.* **2021**, *15*, 189–196. [CrossRef]
277. Yu, M.; Yang, M.R. Effectiveness and Utility of Virtual Reality Infection Control Simulation for Children with COVID-19: Quasi-Experimental Study. *JMIR Serious Games* **2022**, *10*, e36707. [CrossRef]
278. Qin, Y.; Duan, D.; Wang, H.; Chen, X.; Wen, L.; Qin, Y. Application of Virtual Simulation Technology in Human Anatomy Teaching in 5G Environment. In Proceedings of the 2023 6th International Conference on Educational Technology Management (ICETM '23), Guangzhou, China, 3–5 November 2023; Association for Computing Machinery: New York, NY, USA, 2023; pp. 121–128. [CrossRef]
279. Zhang, J. Development and Application Practice of Nursing Simulation Experiment Teaching Platform Under VR Technology. In Proceedings of the 2023 International Conference on Educational Knowledge and Informatization (EKI), Guangzhou, China, 22–24 September 2023; pp. 52–55. [CrossRef]
280. Zhang, L.; Wu, J.; Yang, J.; Chen, S.S.; Liu, J.P.; Zhang, P.; Chu, J.; Luo, C.L. Development and Application Evaluation of a Nursing Simulation Teaching Information System Based on Hospital Information Systems. *Int. J. Clin. Pract.* **2023**, *2023*, 6334967. [CrossRef] [PubMed]
281. Zugai, J.S.; Orr, F.; Levett-Jones, T. Online Gamified Quizzes in Undergraduate Mental Health Nursing Education: Thematic Analysis of Students' Qualitative Views. *Issues Ment. Health Nurs.* **2022**, *43*, 789–793. [CrossRef] [PubMed]
282. Chauvette, A.; Paul, P.; Kleib, M. The impetus of COVID-19 in transforming nursing education through informatics. *Qual. Adv. Nurs. Educ.* **2022**, *8*, 5. [CrossRef]

283. Amankwaa, I.; Boateng, D.; Quansah, D.Y.; Akuoko, C.P.; Desu, A.P.B.; Hales, C. Innovations in Nursing Education in Response to the COVID-19 Pandemic: A Scoping Review. *Nurs. Prax. Aotearoa New Zealand* **2022**, *38*. [CrossRef]
284. 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]
285. Boltsi, A.; Kalovrektis, K.; Xenakis, A.; Chatzimisios, P.; Chaikalis, C. Digital Tools, Technologies, and Learning Methodologies for Education 4.0 Frameworks: A STEM Oriented Survey. *IEEE Access* **2024**, *12*, 12883–12901. [CrossRef]
286. Haleem, A.; Javaid, M.; Qadri, M.A.; Suman, R. Understanding the role of digital technologies in education: A review. *Sustain. Oper. Comput.* **2022**, *3*, 275–285. [CrossRef]
287. 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]
288. 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. [CrossRef]
289. Lampropoulos, G.; Kinshuk. Virtual reality and gamification in education: A systematic review. *Educ. Tech. Res. Dev.* **2024**, 1–95. [CrossRef]
290. 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]
291. Koukourikos, K.; Tsaloglidou, A.; Kourkouta, L.; Papathanasiou, I.V.; Iliadis, C.; Fratzana, A.; Panagiotou, A. Simulation in Clinical Nursing Education. *Acta Inform. Medica* **2021**, *29*, 15–20. [CrossRef]
292. McKitterick, D.J.; Jayasekara, R.; Parker, B. Effectiveness of simulation in undergraduate nursing programs: Systematic review. *Sci. Talks* **2023**, *6*, 100186. [CrossRef]
293. Gebreheat, G.; Whitehorn, L.J.; Paterson, R.E. Effectiveness of Digital Simulation on Student Nurses' Knowledge and Confidence:An Integrative Literature Review. *Adv. Med. Educ. Pract.* **2022**, *13*, 765–775. [CrossRef]
294. Dengri, C.; Gill, A.; Chopra, J.; Dengri, C.; Koritala, T.; Khedr, A.; Korsapati, A.R.; Adhikari, R.; Jain, S.; Zec, S.; et al. A Review of the Quiz, as a New Dimension in Medical Education. *Cureus* **2021**, *13*, e18854. [CrossRef] [PubMed]
295. Sulaiman, M.H.; Jasim, M.S.; Ahmed, A.A.; Ahmed, A.A.; Ibrahim, R.H.; Al-Mashhadany, O.I. A winning formula for nursing education: Effective study strategies and techniques. *Teach. Learn. Nurs.* **2023**, *18*, e142–e145. [CrossRef]
296. Widad, A.; Abdellah, G. Strategies Used to Teach Soft Skills in Undergraduate Nursing Education: A Scoping Review. *J. Prof. Nurs. Off. J. Am. Assoc. Coll. Nurs.* **2022**, *42*, 209–218. [CrossRef] [PubMed]
297. 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]
298. 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]
299. Bourgault, A.; Mayerson, E.; Nai, M.; Orsini-Garry, A.; Alexander, I.M. Implications of the COVID-19 pandemic: Virtual nursing education for delirium care. *J. Prof. Nurs. Off. J. Am. Assoc. Coll. Nurs.* **2022**, *38*, 54–64. [CrossRef]
300. Laari, L.; Anim-Boamah, O.; Boso, C.M. Integrative Review of Soft Skills the Desirable Traits and Skills in Nursing Practice. *Res. Sq.* **2021**, 1–19. [CrossRef]