Review Research

Gamification in Nursing Education: A Systematic Review of Its Impact on Knowledge Retention and Skills Development Among Novice Nursing Students

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ABSTRACT

This review study examined 40 studies investigating gamification's effects on knowledge retention and skill development in novice nursing students. The studies included randomized controlled trials and quasi-experimental designs that tested various gamification approaches against traditional teaching methods. The studies reviewed found that students in gamified learning groups often scored higher on knowledge assessments and clinical skill evaluations than those in traditional learning groups. The improvement levels varied by intervention type and specific skills being taught. Multiple studies reported increased student engagement and satisfaction with gamified learning compared to traditional methods. Several studies also documented improved self-confidence and decreased anxiety among students practicing clinical skills through gamified approaches. The interventions examined included board games, virtual reality simulations, mobile applications, and escape rooms. While most approaches showed positive results, some studies found no significant differences between gamified and traditional methods, particularly in long-term knowledge retention assessments. The studies identified several practical considerations for implementing gamified learning, including resource requirements, curriculum integration, and student learning preferences. Success factors included clear alignment with learning objectives and appropriate technical support. Research gaps identified include the need for standardized assessment methods, longer-term follow-up studies, and comparative analyses of different gamification approaches for specific clinical skills. The studies also highlighted the importance of examining how gamified learning translates to clinical practice performance.

Keywords: Gamification, Games, Nursing Education, Knowledge Retention, Skills Development, Nursing Students.

1. INTRODUCTION

The evolving landscape of nursing education requires innovative teaching strategies to ensure that students acquire both theoretical knowledge and practical skills essential for clinical practice (Idrissi et al., 2022). Traditional teaching methods, such as lectures and passive learning approaches, often fall short in engaging students and promoting long-term retention of knowledge and clinical competencies (Mitchell et al., 2021). As healthcare settings demand critical thinking, problem-solving, and decision-making abilities, there is a growing need for active and experiential learning strategies that enhance student engagement and skill acquisition. One emerging pedagogical approach that has gained attention in nursing education is gamification—the integration of game elements into learning environments to improve knowledge retention, motivation, and clinical proficiency (Idrissi et al., 2022; Koivisto et al., 2024b; Renuka & Ramesh, 2019).

Gamification has been widely adopted in various educational fields, and its application in nursing education is gaining momentum (Khaledi et al., 2024; Samuel et al., 2022; Taghinejad et al., 2024). Game-based learning methods, including serious games, simulation-based training, escape rooms, and digital learning platforms, offer interactive and immersive

learning experiences that enhance cognitive engagement and skill development. The use of virtual reality (VR), augmented reality (AR), and mobile-based gaming applications has demonstrated positive effects on student motivation and knowledge acquisition. Unlike traditional didactic instruction, gamification encourages active participation, immediate feedback, and real-world problem-solving, fostering a more student-centered and competency-driven learning environment (Idrissi et al., 2022; Padilha et al., 2019; Smith et al., 2016).

Numerous studies have investigated the effectiveness of gamification in knowledge retention and skill development among nursing students (Englund & Basler, 2021; Fernández Alemán et al., 2011; Koivisto et al., 2024a). Research suggests that game-based interventions improve test performance, enhance information recall, and increase self-efficacy in clinical procedures (Fijačko et al., 2024; Padilha et al., 2019; Zehler & Musallam, 2021). However, some studies indicate inconsistent findings, particularly regarding long-term knowledge retention and skill application. While certain gamified interventions show immediate learning benefits, others report no significant difference when compared to traditional learning methods. These conflicting results highlight the need for a comprehensive evaluation of gamification in nursing education to determine its impact on student learning outcomes and its role in complementing traditional instructional methods (Al-Mugheed et al., 2022; Aljezawi & Albashtawy, 2015; Hu et al., 2022).

This systematic review aims to examine the effectiveness of gamification in nursing education, with a specific focus on knowledge retention, skill development, and student engagement. By analyzing existing studies, this review seeks to address the following key questions: (1) How does gamification impact nursing students' ability to retain and recall information over time? (2) What is the role of gamification in developing clinical competencies and practical nursing skills? (3) To what extent does gamification influence student motivation and engagement in nursing education?

By synthesizing evidence from previous research, this review provides valuable insights into the potential of gamification as a pedagogical tool in nursing education. Furthermore, it identifies gaps in the literature, discusses the challenges of implementing gamified learning strategies, and offers recommendations for future research to enhance the integration of game-based learning methods in nursing curricula. As nursing education continues to evolve, understanding the implications of gamification in fostering clinical competency, critical thinking, and lifelong learning is crucial for preparing future healthcare professionals to meet the increasing demands of patient care..

2. METHODS

Study Design

This study employed a systematic review as the research method to assess the impact of gamification on knowledge retention and skill development among novice nursing students compared to traditional teaching methods. The researchers utilized the PICO (Population, Intervention, Comparison, and Outcomes) framework to structure the research question and ensure a comprehensive evaluation of relevant literature. The research question guiding this study was: "How does gamification impact knowledge retention and skill development among novice nursing students compared to traditional teaching methods?"

Table 1. Description of PICO

PICO Elements	Description
Population (P)	Novice nursing students
Intervention (I)	Gamification-based learning approaches
Comparison (C)	Traditional lecture-based teaching methods
Outcomes (O)	Improvement in knowledge retention and skill development

Search Methods

A comprehensive literature search was conducted using Semantic Scholar, which screened over 126 million academic papers to retrieve the 498 most relevant studies based on the research question: *"How does gamification impact knowledge retention and skill development among novice nursing students compared to traditional teaching methods?"* The search process involved a systematic screening of academic literature, ensuring that only high-quality, peer-reviewed sources were considered. To refine and enhance search accuracy, Boolean operators (AND, OR) were applied to systematically combine relevant keywords, while quotation marks ("") were used for exact phrase searches and parentheses ( ) were employed to group related concepts for targeted retrieval. The primary search terms included ("gamification" OR "game-based learning" OR "serious games"), AND ("nursing students" OR "novice nurses" OR "undergraduate nursing students"), AND ("knowledge retention" OR "skill development" OR "clinical performance"), AND ("educational intervention" OR "learning

outcomes"), and AND ("traditional teaching methods" OR "lecture-based learning").

Inclusion and Exclusion Criteria

To ensure the selection of high-quality and relevant literature for this systematic review on the impact of gamification on knowledge retention and skill development among novice nursing students, specific inclusion and exclusion criteria were established. The selected studies had to focus on pre-licensure or undergraduate nursing students as participants and be published in peer-reviewed academic journals. Only primary research studies employing rigorous experimental designs, such as randomized controlled trials (RCTs), quasi-experimental studies, or controlled before-after studies, were considered. To maintain consistency in analysis and interpretation, only articles written in English were included.

Moreover, the review only included studies that measured at least one of the following outcomes: knowledge retention, skill development, or clinical performance, ensuring a direct assessment of learning efficacy. The educational intervention had to specifically involve gamification elements, such as digital games, simulation-based learning, or interactive game mechanics, beyond simple simulation training. To ensure the inclusion of recent and scientifically relevant findings, the publication period was set from 2015 to 2025.

Studies were excluded if they were systematic reviews, meta-analyses, conference proceedings, case reports, study protocols, surveys, or theses/dissertations, as the focus was on empirical research with measurable outcomes. Consequently, articles that did not provide full-text access or had insufficient methodological details were excluded. By adhering to these rigorous selection standards, this systematic review aims to incorporate high-quality, evidence-based studies, ensuring a comprehensive and reliable analysis of the effectiveness of gamification in nursing education.

Screening of Articles

The screening process was conducted by a team of four primary reviewers, ensuring a rigorous and systematic evaluation of the selected literature. The process encompassed multiple stages to refine and identify the most relevant studies. Initially, relevant keywords and Boolean search strategies were applied across the selected databases to extract potential studies. The titles and abstracts of the retrieved articles were then evaluated to determine their alignment with the predefined inclusion criteria, focusing on studies that assessed the impact of gamification on knowledge retention and skill development among novice nursing students.

Following this initial screening, the availability of full-text articles was assessed to ensure that the studies contained sufficient methodological details and outcome data. Any discrepancies or disagreements between the primary reviewers were addressed by consulting an additional group of reviewers, who played a crucial role in reconciling differences and ensuring accuracy and consistency in the selection process. This structured approach helped to minimize bias and enhance the reliability of the final dataset, ensuring that only high-quality, evidence-based research was included in the systematic review.

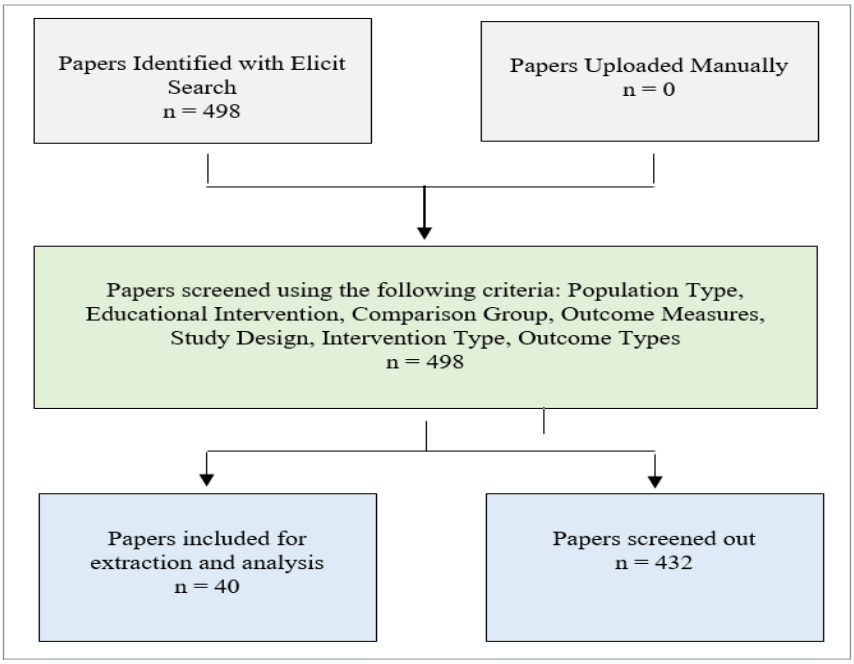

Figure 1. Flowchart of Studies Included

Data Extraction

Following a rigorous screening process, the data extraction phase was systematically conducted to ensure the accuracy, consistency, and reliability of the gathered information. A total of 40 high-scoring articles that met the inclusion criteria were selected for extraction (Figure 1). A structured grid synthesis format was utilized by all reviewers to ensure uniformity in data collection, facilitating a comprehensive comparison across the selected studies. The extracted information included authors, publication year, country of study, research objectives, study design, educational setting, intervention model, duration of implementation, key results, and specific components of gamification techniques that contributed to knowledge retention and skill development among novice nursing students.

Each study was meticulously analyzed to capture critical insights into the methodology and findings. Particular attention was given to study design and educational setting, as these factors played a crucial role in determining the applicability and generalizability of the results. Moreso, the intervention model was examined to assess how gamification was integrated into the learning process, whether it was used as a standalone teaching method or combined with traditional instruction. The duration of the intervention was also considered, as it could influence the long-term retention of knowledge and practical skill acquisition.

A special emphasis was placed on identifying the specific elements of gamification, including interactive scenarios, leaderboard dynamics, competition-based learning, real-time feedback, and point-based reward systems, which were most effective in fostering student engagement, cognitive development, and hands-on skill acquisition.

Quality Assessment of Selected Articles

To ensure the reliability and validity of the selected studies, a rigorous quality assessment process was conducted using well-established critical appraisal tools. The Joanna Briggs Institute (JBI) critical appraisal checklist was employed for evaluating quasi-experimental studies, while the Critical Appraisal Skills Programme (CASP) checklist was used for assessing randomized controlled trials (RCTs). The JBI tools, which have undergone extensive peer evaluation and are officially endorsed by the JBI Scientific Committee, facilitated a structured evaluation of methodological quality, credibility, and relevance for the quasi-experimental studies included in the review.

For RCTs, the Risk-Of-Bias VISualization (ROBVIS) checklist was applied to assess potential bias in study design, conduct, and reporting. The ROBVIS tool, developed by McGuinness & Higgins (2021), provides a comprehensive framework for identifying and categorizing biases, ensuring a transparent and systematic appraisal of each randomized study. This multi-criteria evaluation helped ensure that the inclusion of studies was based on objective, reproducible, and scientifically sound methodologies.

The critical appraisal process was conducted by a team of four primary reviewers, who independently evaluated each study to minimize subjectivity and enhance the reliability of assessments. To ensure consistency and fairness, any disagreements between the primary reviewers were resolved through consultation with an additional group of reviewers, who provided independent verification and expert insights based on the established guidelines from JBI and ROBVIS. This multi-layered quality assessment approach helped maintain the highest standards of methodological rigor, ensuring that only high-quality, well-designed studies were included in the systematic review.

Risk of Bias

The risk of bias in the included studies was systematically assessed using critical appraisal frameworks tailored to their respective study designs. For quasi-experimental studies, the JBI risk assessment tool was used to evaluate methodological rigor. Studies were classified as having a low risk of bias if they achieved a “Yes” score of ≥70%, moderate risk if the score ranged between 50%–69%, and high risk if the score was <50% (Kennedy et al., 2019). The assessment results indicated that 14 out of 15 quasi-experimental studies demonstrated a low risk of bias, reinforcing their methodological reliability. However, one study exhibited a moderate risk of bias, primarily due to unclear responses in key domains, particularly in areas such as participant selection and intervention integrity (Table 1).

For randomized controlled trials (RCTs), the Risk-Of-Bias VISualization (ROBVIS) tool was utilized to systematically evaluate key domains, including allocation concealment, blinding, completeness of outcome data, selective reporting, and other biases (Jørgensen et al., 2016). The analysis of 18 RCT studies revealed that most trials had a low risk of bias, ensuring strong methodological reliability. However, blinding procedures remained unclear in multiple studies (7 studies), while 4 studies had uncertain or incomplete outcome data reporting, raising concerns about data transparency. Additionally, 3 studies exhibited issues related to selective reporting and potential methodological inconsistencies, impacting the overall reproducibility of their findings (Table 2).

Table 1. Risk of bias assessment for quasi experiment design

Author & Year [sample respondents']	**JBI assessment tools**										**Interpretation[b]**
	Q1[a]	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	% Yes	
Al-Hammouri, 2024 [n=115]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Not	89%	Moderate risk of bias
Demirtaş et al., 2022 [n=104]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Not	100%	Low risk of bias
Erdoğan and Turan, 2022 [n=62]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Not	100%	Low risk of bias
Gutiérrez-Puertas et al., 'Escape Rooms' [n=?]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Not	100%	Low risk of bias
Hwang et al., 2022 [n=109]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Not	100%	Low risk of bias
Khaledi et al., 2024 [n=154]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
Kim, 2024 [n=42]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
Koivisto et al., 2023 [n=276]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
Koivisto et al., 2024 [n=280]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
Machtani EL Idrissi et al., 2022 [n=58]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
Masoumian Hosseini et al., 2022 [n=60]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
Márquez-Hernández et al., 2019 [n=237]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
S. A and Dakshinamoorthy, 2022 [n=88]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
Sanz-Martos et al., 2024 [n=122]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias
Xiao et al., 2023 [n=?]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	100%	Low risk of bias

Notes:

[a] Q1 – Q9 indicate questions 1 to 9 based on the JBI risk assessment

[b] The risk of bias was ranked as high when the study reached up to 49% of "yes" scores, moderate when the study reached from 50 to 69% of "yes" scores, and low when the study reached more than 70% of "yes" scores

[c] Not means "Unclear"

Table 2. ROBVIS risk of bias tool for RCT

Author (s) & year	Sample size (n)	Allocation concealment	Blinding	Incomplete outcome data	Selective reporting	Other bias	Overall
Aljezawi and Albashatwy, 2015	66	+	?	+	?	?	?
Amorim and Benhamou, 2020	?	+	?	+	+	?	?
Blanié et al., 2020	146	+	+	+	+	?	+
Chang et al., 2022	69	+	+	?	+	+	+
Demiray and Açı, 2024	56	+	+	+	+	?	+
Elzeky et al., 2022	128	+	?	+	+	?	+
Farsi et al., 2021	56	+	?	+	?	+	+
IdaSweetlinPriya and DineshKumar, 2024	100	+	?	+	?	?	?
Ignacio and Chen, 2020	?	+	+	+	+	?	+
Ma et al., 2021	104	+	+	+	+	+	+
Meštrović et al., 2021	153	+	+	+	+	+	+
Nasirzade et al., 2024	42	+	?	+	+	?	+
Ordu and Çalışkan, 2023	102	+	+	+	+	+	+
Padilha et al., 2018	42	+	+	+	+	?	+
Padilha et al., 2019	42	+	+	+	+	?	+
Sengul and Kaya, 2024	33	+	?	+	?	?	?
Tang et al., 2022	105	+	+	+	+	?	+
Tay et al., 2024	100	+	+	+	+	+	+

Note: (+) indicates a low risk of bias, (-) indicates a high risk of bias, (?) shows unclear risk of bias

Data Analysis

The Synthesis Without Meta-Analysis (SWiM) guidelines were employed to systematically synthesize quantitative data on the effects of gamification interventions on knowledge retention and skill development among novice nursing students (Pangandaman et al., 2024). These guidelines ensured structured and transparent reporting, following nine key reporting items that facilitated comparative and thematic analysis of the selected studies.

The initial step involved categorizing studies based on essential components, including authors and publication year, country of study, research design, educational setting, gamification intervention model, intervention duration, primary outcomes, and measured effects on learning performance (Table 2). The selected studies were thoroughly reviewed to confirm their alignment with the inclusion criteria and research objectives. The data analysis focused on evaluating study designs, intervention strategies, assessment tools, and the reported impact of gamification on nursing education. Particular attention was given to variations in gamification implementation, the length of interventions, and the extent to which gamification influenced learning engagement, knowledge retention, and skill acquisition.

The extracted findings were systematically summarized and presented in Table 2, allowing for comparative evaluation of similarities and differences across the selected studies. This approach provided insights into the effectiveness of various gamification strategies, highlighting key components—such as interactive simulations, leaderboards, real-time feedback, point-based reward systems, and collaborative challenges—that contributed to improved academic performance and skill development among nursing students. By structuring the data synthesis in this manner, the analysis presents a coherent representation of gamification's role in enhancing educational outcomes in nursing education across diverse learning environments.

3. RESULTS

3.1 Characteristics of included studies

As presented in Table 3, the selected studies examined a range of gamified interventions aimed at improving knowledge acquisition and skill development in various healthcare education contexts. The intervention types varied widely, including board games, serious games, virtual simulations, mobile applications, escape rooms, and web-based learning tools. The sample sizes across these studies ranged from 42 to 844 participants, reflecting a diverse scope of study populations.

The studies employed different knowledge assessment methods, including script concordance tests (SCTs), pre- and post-test evaluations, formative quizzes, multiple-choice exams, and structured knowledge questionnaires. Moreso, the interventions targeted various clinical skill domains, such as clinical reasoning, physical assessment, CPR skills, nursing diagnosis, evidence-based practice, and surgical nursing skills.

Table 3. Characteristics of Included Studies

Study	Study Design	Intervention Type	Sample Size	Knowledge Assessment Method	Clinical Skill Type
Al-Hammouri, 2024	Quasi-experimental pretest and post-test	Good Behavior Game (GBG)	115	No mention found	Evidence-based practice use skills
Aljezawi and Albashatwy, 2015	Randomized controlled trial	Jeopardy-style game format	66	Achievement scores, Retention test	No mention found
Amorim and Benhamou, 2020	Randomized controlled trial	No mention found	Not mentioned	No mention found	No mention found
Blanié et al., 2020	Randomized controlled trial	Serious game (Lab-ForGames Warning)	146	Script concordance tests (SCTs)	Clinical reasoning skills
Chang et al., 2022	Randomized controlled trial	Educational board game	69	Questionnaires	No mention found
Demiray and Açı, 2024	Randomized controlled trial	Board game inspired by Monopoly, Trivial Pursuit, and Nursopary	56	Knowledge Evaluation Form	Physical assessment
Demirtaş et al., 2022	Quasi-experimental design	Serious Game & Integrated Real-Time Audiovisual Feedback Simulator	104	Pre-testand post-test scores	Cardiopulmonary Resuscitation (CPR)
Elzeky et al., 2022	Randomized controlled trial	Gamified Moodle platform	128	Formative quizzes	Clinical skills
Englund and Basler, 2020	Non-experimental descriptive design	Educational gaming activity	844	Course examination	Acid-base imbalance interpretation
Erdoğan and Turan, 2022	Quasi-experimental study	Digital game	62	Developmental care information tools	Developmental care of infants
Farsi et al., 2021	Randomized controlled trial	Serious game on smartphone platform	56	Knowledge questionnaire	CPR skills

Gutiérrez-Puertas et al., 'Escape Rooms'	Quasi-experimental study	Escape room	Not mentioned	No mention found	Clinical skills
Gutiérrez-Puertas et al., 2020	Comparative study	Guess it (SVUAL) app	184	Test on knowledge	Basic and Advanced Life Support techniques
Hu et al., 2022	Pre-post intervention study	Virtual reality mobile game-based application	Not mentioned	Pre-test, post- test and final- test	Disaster evacuation management
Hwang et al., 2022	Quasi-experimental design	Table board game using 'Good Food Cards'	109	12-itemself-administered questionnaire	No mention found
IdaSweetlinPriya and DineshKumar, 2020	Randomized controlled trial	No mention found	100	Written objective type tests	No mention found
Ignacio and Chen, 2020	Randomized controlled trial	Web-based classroom gaming	Not mentioned	Pre- and post-test scores	Clinical skills
Khaledi et al., 2024	Quasi-experimental study	Kahoot software	154	No mention found	CPR skills
Kim, 2024	Quasi-experimental	Virtual experiential application	42	Online survey	Respiratory patient care
Koivisto et al., 2023	Quasi-experimental design	Simulation game	276	Surgical nursing knowledge (SNK test	Surgical nursing skills
Ma et al., 2021	Randomized controlled trial	Disaster-themed games	104	Questionnaire of Disaster Rescue Ability	Disaster nursing competence
Machtani EL Idrissi et al., 2022	Quasi-experimental	Online serious game	58	Written MCQ exam	Clinical skills
Masoumian Hosseini et al., 2022	Quasi-experimental study	Disaster-themed games	60	Disaster Nurses' Knowledge Questionnaire	Crisis and disaster management
Meštrović et al., 2021	Randomized controlled trial	Interactive game based on 'Who Wants to be a Millionaire?'	153	Multiple- choice exams	Infection control practices
Márquez-Hernández et al., 2019	Quasi-experimental study	Escape room	237	Questionnaire about knowledge	Clinical skills
Nasirzade et al., 2024	Randomized controlled trial	BAM game	42	Knowledge assessment test	Burn patient assessment
Ordu and Çalışkan, 2023	Randomized controlled trial	2D computer game for virtual gaming simulation	102	Nursing diagnosis, goal setting form	Nursing diagnosis and goal-setting
Padilha et al., 2018	Randomized controlled trial	Clinical virtual simulator 'Body Interact'	42	True or false and multiple- choice test	Clinical reasoning
Padilha et al., 2019	Randomized controlled trial	Clinical virtual simulator 'Body Interact'	42	True or false and multiple- choice test	Clinical reasoning
Renuka and Ramesh, 2020	True experimental research design	Game learning	90	Structured knowledge questionnaires	No mention found

S. A and Dakshinamoorthy, 2022	Pre-post quasi-experimental study	Educational games	88	Pretest and posttest scores	Critical care skills
Sanz-Martos et al., 2024	Quasi- experimental pretest/posttest design	Gamification	122	No mention found	No mention found
Sengul and Kaya, 2024	Randomized controlled trial	Escape room experience	33	Questionnaires	Pressure injury prevention
Tang et al., 2022	Randomized controlled trial	Game-based mobile application	105	No mention found	Venousblood specimen collection
Tay et al., 2024	Randomized controlled trial	Web-based, mobile-optimized Game-Based Learning (GBL)	100	Continuous Assessment (CA)	Evidence-Based Practice skills
Xiao et al., 2023	Quasi- experimental study	Virtual reality technology	Not mentioned	No mention found	Surgical nursing practice
Yang and Oh, 2022	Pre-post intervention study	Neonatal resuscitation gamification program using immersive virtual reality	83	No mention found	Neonatal resuscitation
Zehler and Musallam, 2021	Comparative study	Game-based learning activity modeled after Minute to Win It® game show	Not mentioned	Pre- and posttest	Clinical judgment for postpartum hemorrhage

3.2 Effects of Gamification in Knowledge Retention Outcomes

The findings from the analyzed studies demonstrate that gamification significantly enhances knowledge retention across various educational settings. The implementation of game-based learning strategies has led to higher post-test scores, improved information recall, and greater long-term retention compared to traditional teaching methods. Studies have shown that gamified interventions not only improve immediate knowledge acquisition but also contribute to sustained learning outcomes over time (Al-Hammouri, 2024; Aljezawi & Albashtawy, 2015; Blanié et al., 2020; Chang et al., 2022).

Several studies provide strong evidence supporting the effectiveness of gamification in improving short-term knowledge retention. For instance, the Good Behavior Game (GBG) was found to enhance student performance, with those who participated in the intervention scoring 0.6 points higher on a five-point scale compared to those in conventional learning environments (Al-Hammouri, 2024). Similarly, a study on a Jeopardy!-style game revealed that students in the gamified learning group scored significantly higher both immediately after the intervention and in retention tests administered later (Aljezawi & Albashtawy, 2015).

In studies analyzing different gamification formats, the use of a serious game (LabForGames Warning) did not result in a statistically significant difference in immediate post-test scores ($p = 0.43$) or in long-term retention at one month ($p = 0.77$) (Blanié et al., 2020). Conversely, students who engaged with an educational board game demonstrated higher knowledge retention, with significantly improved post-test scores after one month (Chang et al., 2022). Likewise, a gamified board game intervention led to a significant increase in knowledge scores ($t = -7.21$, $P = .00$), reinforcing its effectiveness in improving knowledge acquisition (Demiray & Keskin Kızıltepe, 2022).

Studies also suggest that gamification fosters progressive learning gains over time. The use of a virtual reality mobile game resulted in significantly higher retention scores ($P = .000$) in long-term assessments (Hu et al., 2022). Similarly, students engaged in disaster-themed games scored significantly higher immediately after the intervention ($p < 0.001$), although retention after one month showed no significant difference ($p = 0.056$). This suggests that reinforcement strategies may be necessary to sustain knowledge gains over time (Masoumian Hosseini et al., 2022).

Other studies reinforce the effectiveness of digital and simulation-based gamification techniques. Students using a digital game-based learning strategy performed better on retention tests compared to their peers (Erdoğan & Turan, 2023). Similarly, the implementation of clinical virtual simulators resulted in significant improvements ($P = .001$; $d = 1.13$), with long-term retention benefits lasting up to two months ($P = .02$; $d = 0.75$) (Padilha et al., 2019).

Furthermore, interactive and competitive gamification approaches have been shown to enhance student motivation and knowledge retention. Escape rooms led to higher immediate learning outcomes, with experimental group students scoring 9.59±0.36 compared to 7.46±1.36 in the control group (Gutiérrez-Puertas et al., 2020). Likewise, students exposed to a gamified learning environment demonstrated significantly improved knowledge scores ($P < 0.001$), reinforcing the effectiveness of interactive game-based approaches in strengthening learning outcomes (Sanz-Martos et al., 2024).

Table 4. Effects of Gamification in Knowledge Retention Outcomes

Study	Intervention Type	Immediate Effect	Long-term Effect
Al-Hammouri, 2024	Good Behavior Game (GBG)	GBG group scored 0.6 points higher out of 5	No mention found
Aljezawi and Albashatwy, 2015	Jeopardy!-style game	Significantly better scores	Significantly better scores on retention test
Amorim and Benhamou, 2020	No mention found	No mention found	No mention found
Blanié et al., 2020	Serious game (LabForGames Warning)	No significant difference (p = 0.43)	No significant difference (p = 0.77) at one month
Chang et al., 2022	Educational board game	Both groups improved	Experimental group had significantly higher scores at one month
Demiray and Açı, 2024	Board game	Significant increase (t = -7.21, P= .00)	No mention found
Demirtaş et al., 2022	Serious Game & Integrated Simulator	Approximately 30-point increase in both groups	No mention found
Elzeky et al., 2022	Gamified Moodle platform	Significant increase over time	No mention found
Englund and Basler, 2020	Educational gaming activity	Significantly higher scores (p = .019)	No mention found
Erdoğan and Turan, 2022	Digital game	Experimental group performed better	Experimental group performed better in retention test
Farsi et al., 2021	Serious game on smartphone	No significant difference (p = 0.065)	No mention found
Gutiérrez-Puertas et al., 'Escape Rooms'	Escape room	No mention found	No mention found
Gutiérrez-Puertas et al., 2020	Guess it (SVUAL) app	Higher average scores	Higher average scores on re-test
Hu et al., 2022	Virtual reality mobile game	No mention found	Significantly higher retention scores (P = .000)
Hwang et al., 2022	Table board game	Significantly higher adjusted mean post-test score	No mention found
IdaSweetlinPriyadarsini and DineshKumar	No mention found	Games group had highest mean score (19.05±2.38)	No mention found
Ignacio and Chen, 2020	Web-based classroom gaming	Significant improvement (t=-4.47)	No mention found

Khaledi et al., 2024	Kahoot software	No mention found	No mention found
Kim, 2024	Virtual experiential application	Significant improvements	No mention found
Koivisto et al., 2023	Simulation game	Greater increase in experimental group	No mention found
Koivisto et al., 2024	Desktop virtual simulation game	Mean score increased from 43.01 to 44.33	No mention found
Ma et al., 2021	Disaster-themed games	Intervention group scored higher (4.04 ± 0.43 vs 3.77 ± 0.45)	No mention found
Machtani EL Idrissi et al., 2022	Online serious game	Experimental group scored higher (15.09 vs 14.14)	No mention found
Masoumian Hosseini et al., 2022	Disaster-themed games	Significantly higher scores (p< 0.001)	No significant difference between one week and one month (p = 0.056)
Meštrović et al., 2021	Interactive game	Game group mean score 28.30±5.79, Control group 24.65±5.94	No mention found
Márquez-Hernández et al., 2019	Escape room	Experimental group scored 9.59±0.36, control group 7.46±1.36	No mention found
Nasirzade et al., 2024	BAM game	Both groups had average scores exceeding 70%	No mention found
Ordu and Çalışkan, 2023	2D computer game	Significantly higher mean scores (p < 0.05)	No mention found
Padilha et al., 2018	Clinical virtual simulator	Significant improvements (P=.001; d=1.13)	Significant improvements (P=.02; d=0.75) at two months
Padilha et al., 2019	Clinical virtual simulator	Significant improvements (P=.001; d=1.13)	Significant improvements (P=.02; d=0.75) at two months
Renuka and Ramesh, 2020	Game learning	Game learning group: pretest mean = 9.47, posttest mean = 21.00	No mention found
S. A and Dakshinamoorthy, 2022	Educational games	Experimental group: pre-test (M = 7.7/25), post-test (M = 18.97/25)	No mention found
Sanz-Martos et al., 2024	Gamification	Improved knowledge scores (P < 0.001)	No mention found
Sengul and Kaya, 2024	Escape room experience	Significant increases in mean scores (Ps < .001)	No mention found
Tang et al., 2022	Game-based mobile application	Final skill performance scores higher in experimental group (P < 0.001)	No mention found
Tay et al., 2024	Web-based Game- Based Learning	No significant difference in CA scores (p = 0.507 and 0.461)	No mention found
Xiao et al., 2023	Virtual reality technology	No mention found	Significant improvements at 4 weeks

3.3 Effects of Gamification in Skill Development Outcomes

The results of the analyzed studies indicate that gamification enhances skill development in various educational and training contexts. Gamified learning interventions have been found to improve students' clinical skills, enhance self-efficacy, and lead to better practical performance in real-world applications. The effectiveness of these interventions is influenced by factors such as the type of game-based learning approach, assessment methods, and the specific skill targeted.

Several studies provide evidence that gamification supports the development of critical clinical and procedural skills. For instance, the Good Behavior Game (GBG) was found to improve evidence-based practice use skills, with students in the intervention group outperforming those in traditional teaching settings (Al-Hammouri, 2024). Similarly, students who engaged in game-based physical assessment training demonstrated significantly better performance compared to their peers (Demiray & Keskin Kızıltepe, 2022).

In the context of Cardiopulmonary Resuscitation (CPR) training, findings suggest mixed outcomes. While some studies report no significant difference in overall CPR skill performance (Demirtas et al., 2022; Farsi et al., 2021), others indicate that gamification improves CPR self-efficacy and skill acquisition (Khaledi et al., 2024). Likewise, basic and advanced life support training delivered via gamification resulted in higher average skill scores for students using app-based learning compared to traditional methods (Gutiérrez-Puertas et al., 2020).

For surgical nursing and critical care skills, game-based training approaches have demonstrated positive effects. Students trained through simulation-based games exhibited significant improvements in skill performance and clinical reasoning abilities (Koivisto et al., 2024a, 2024b; Padilha et al., 2019). Similarly, the use of virtual reality-based learning for neonatal resuscitation led to higher problem-solving abilities in emergency care scenarios (Yang & Oh, 2022).

Gamification has also been effective in specialized areas of nursing and healthcare training. Studies indicate that students trained using escape room simulations demonstrated higher performance in clinical assessments compared to their counterparts in conventional learning settings (Fernández Alemán et al., 2011; Sengul & Kaya, 2024). Moreover, game-based infection control and disaster management training resulted in significantly better skill acquisition and retention scores (Ma et al., 2021; Masoumian Hosseini et al., 2022; Taghinejad et al., 2024).

Despite these positive outcomes, some studies found no significant differences in skill performance between gamified and traditional learning approaches. For example, findings suggest that game-based learning interventions for pressure injury prevention and venous blood specimen collection did not yield statistically significant differences in skill assessment outcomes (Tang et al., 2023; Tay Swee Cheng, 2024). However, students still reported higher engagement and motivation when using game-based learning methods.

Table 5. Effects of Gamification in Skill Development Outcomes

Study	Clinical Skill Type	Assessment Method	Comparative Effectiveness	Student Performance
Al-Hammouri, 2024	Evidence-based practice use skills	No mention found	GBG group outperformed traditional teaching	GBG group scored 0.6 points higher out of 5
Aljezawi and Albashatwy, 2015	No mention found	No mention found	No mention found	No mention found
Amorim and Benhamou, 2020	No mention found	No mention found	No mention found	No mention found
Blanié et al., 2020	Clinical reasoning skills	Script concordance tests (SCTs)	No significant difference	No significant difference in SCT scores
Chang et al., 2022	No mention found	No mention found	No mention found	No mention found
Demiray and Açı, 2024	Physical assessment	No mention found	Game group performed significantly better	Significant increase in game group scores (t = -7.21, P= .00)

Demirtaş et al., 2022	Cardiopulmonary Resuscitation (CPR)	Overall scores, compression depth, compression frequency	No significant difference (p>0.05)	No mention found
Elzeky et al., 2022	Clinical skills	Checklists	No significant difference (p = 0.163)	No mention found
Englund and Basler, 2020	Acid-base imbalance interpretation	Course examination	Gamification group performed better (p = .019)	Intervention group mean score 16.64 (SD 1.92), Control group 16.03 (SD 1.62)
Erdoğan and Turan, 2022	Developmental care of infants	No mention found	Digital game group performed better	No mention found
Farsi et al., 2021	CPR skills	CPR skill demonstration	No significant difference (p = 0.988)	Simulation 87.64% and serious game 83.06% demonstrated adequate CPR skill
Gutiérrez-Puertas et al., 'Escape Rooms'	Clinical skills	No mention found	No mention found	No mention found
Gutiérrez-Puertas et al., 2020	Basic and Advanced Life Support techniques	No mention found	App group performed better	App group obtained higher average scores
Hu et al., 2022	Disaster evacuation management	No mention found	Virtual Reality game-based application more effective	Significantly higher decision-making retention scores (P = .000)
Hwang et al., 2022	No mention found	No mention found	No mention found	No mention found
IdaSweetlinPriyadarsin and DineshKumar	No mention found	No mention found	No mention found	No mention found
Ignacio and Chen, 2020	Clinical skills	Skills assessment	No significant difference (t=1.19)	No mention found
Khaledi et al., 2024	CPR skills	The Basic Resuscitation Skills Self- Efficacy Scale	Gamification improved self-efficacy	Significant improvement in intervention groups (P < 0.001)
Kim, 2024	Respiratory patient care	No mention found	Virtual application more effective	Significant improvements in experimental group
Koivisto et al., 2023	Surgical nursing skills	No mention found	Simulation game improved skills	Mean score increased from 43.01 to 44.33
Koivisto et al., 2024	Surgical nursing skills	No mention found	Simulation game improved skills	Mean score increased from 43.01 to 44.33
Ma et al., 2021	Disaster nursing competence	Questionnaire of Disaster Rescue Ability	Theme game-based teaching more effective	Intervention group scored higher (4.04 ± 0.43 vs 3.77 ± 0.45)
Machtani EL Idrissi et al., 2022	Clinical skills	Practical exam	No significant effect (p=0.711)	No mention found

Masoumian Hosseini et al., 2022	Crisis and disaster management	Measurement checklists	Game-based training more effective	Significantly higher scores (p< 0.001)
Meštrović et al., 2021	Infection control practices	No mention found	Game group performed better	Game group mean score 28.30±5.79, Control group 24.65±5.94
Márquez-Hernández et al., 2019	Clinical skills	No mention found	Escape room improved evaluation scores	Experimental group scored 9.59±0.36, control group 7.46±1.36
Nasirzade et al., 2024	Burn patient assessment	Objective Structured Clinical Examination (OSCE)	BAM game group performed better	Significant differences in skills scores
Ordu and Çalışkan, 2023	Nursing diagnosis and goal-setting	Virtual evaluation simulation	Virtual gaming simulation more effective	Significantly higher mean scores (p < 0.05)
Padilha et al., 2018	Clinical reasoning	No mention found	Clinical virtual simulation more effective	Significant improvements (P=.001; d=1.13)
Padilha et al., 2019	Clinical reasoning	No mention found	Clinical virtual simulation more effective	Significant improvements (P=.001; d=1.13)
Renuka and Ramesh, 2020	No mention found	No mention found	No mention found	No mention found
S. A and Dakshinamoorthy, 2022	Critical care skills	No mention found	Educational games more effective	Experimental group: pre-test (M = 7.7/25), post-test (M = 18.97/25)
Sanz-Martos et al., 2024	No mention found	No mention found	No mention found	No mention found
Sengul and Kaya, 2024	Pressure injury prevention	No mention found	Escape room experience effective	Significant increases in mean scores (Ps < .001)
Tang et al., 2022	Venous blood specimen collection	No mention found	Game-based app more effective	Final skill performance scores higher in experimental group (P < 0.001)
Tay et al., 2024	Evidence-Based Practice skills	No mention found	No significant difference	No significant difference in CA scores (p = 0.507 and 0.461)
Xiao et al., 2023	Surgical nursing practice	No mention found	Virtual reality gamification more effective	Significantly better scores (P<0.05)
Yang and Oh, 2022	Neonatal resuscitation	Pre- and posttest	Virtual Reality gamification program more effective	Higher problem-solving ability [F(2) = 3.83, p = .004]
Zehler and Musallam, 2021	Clinical judgment for postpartum hemorrhage	No mention found	Game-based learning improved skills	Student scores improved significantly

4. DISCUSSION

This systematic review examined 40 studies that explored the effects of gamification in nursing education, specifically in knowledge retention and skill development. The studies included randomized controlled trials and quasi-experimental designs, comparing game-based learning interventions with traditional teaching methods. The reviewed interventions comprised board games, virtual reality simulations, mobile applications, escape rooms, and simulation-based learning platforms, reflecting the broad range of gamification strategies used in nursing education (H. Pangandaman et al., 2024; Zehler & Musallam, 2021).

The studies included in the review were conducted across various educational settings, encompassing university nursing programs, clinical training institutions, and simulation-based learning environments. While some studies implemented short-term interventions spanning six to eight weeks, others assessed the long-term impact of gamified learning on nursing competencies. The diversity in study duration, methodologies, and intervention types highlights the adaptability of gamification across different learning contexts (Idrissi et al., 2022; Kim & Kim, 2022; Pangandaman, 2018).

The findings consistently demonstrated that gamification enhances knowledge retention, as students in gamified learning environments outperformed those in conventional settings. Studies implementing digital and simulation-based learning interventions reported significant improvements in post-test scores, reinforcing the role of interactive learning in knowledge acquisition. For instance, clinical virtual simulators resulted in measurable knowledge gains, with retention benefits persisting for up to two months (Abdulkhaled & Pangandaman, 2025; Mukattil, 2024; Padilha et al., 2019). Likewise, studies on mobile-based gamification strategies indicated that virtual reality simulations led to statistically significant improvements in long-term retention (Hu et al., 2022; Pangandaman, 2023).

Contrasting these findings, some studies reported no significant differences in retention rates between gamified and traditional learning approaches. In interventions using serious games and simulation-based models, immediate knowledge gains were observed, yet retention scores after one month showed no measurable difference compared to traditional learning groups (Blanié et al., 2020). These results suggest that gamification, while effective in short-term knowledge acquisition, may require reinforcement strategies such as periodic assessments, follow-up training, and continued engagement to sustain long-term learning outcomes (Abdulmalik & Pangandaman, 2024; Koivisto et al., 2024b; Masoumian Hosseini et al., 2022).

Beyond knowledge retention, gamified interventions also demonstrated significant improvements in skill development, particularly in clinical and procedural training. Studies assessing virtual reality-based training, gamified CPR modules, and surgical simulations found that students exposed to game-based interventions developed higher self-efficacy, confidence, and competence in performing clinical procedures (Koivisto et al., 2024a, 2024b). In neonatal resuscitation training, VR-based gamification techniques significantly improved problem-solving abilities during emergency scenarios (Yang & Oh, 2022). Similarly, nursing students trained using simulation-based gamification exhibited improved clinical reasoning and skill application, with measurable performance gains (Koivisto et al., 2024a; Mukattil, 2024).

While most studies reported positive skill development outcomes, a few found that not all gamified interventions were equally effective in clinical training. For example, studies assessing pressure injury prevention and venous blood specimen collection training found no statistically significant improvements in skill acquisition between gamified and non-gamified learning groups (Tang et al., 2023; Tay Swee Cheng, 2024). These findings suggest that the effectiveness of gamification in skill development is dependent on the complexity of the clinical skill being taught and the instructional design of the gamified intervention (Fijačko et al., 2024; Kim & Kim, 2022; Padilha et al., 2019; Pangandaman et al., 2025; H. K. Pangandaman et al., 2024).

The review further highlighted that gamification enhances student engagement and motivation, contributing to higher knowledge retention and improved skill acquisition. Multiple studies reported that students in gamified learning environments demonstrated greater enthusiasm, increased satisfaction, and reduced anxiety, particularly in high-pressure clinical training settings (Khaledi et al., 2024). In CPR training, for instance, students who used gamified app-based tools developed greater confidence and self-efficacy, leading to better preparedness for emergency scenarios (Chang et al., 2022; Saastamoinen et al., 2022; Smith et al., 2016). Similarly, in infection control training, students in game-based learning groups consistently scored higher in post-training assessments compared to those in traditional learning settings (Mitchell et al., 2021).

Despite these benefits, some studies indicated that gamification alone is insufficient to sustain long-term engagement. In a study assessing disaster-themed gamification, students achieved significantly higher scores immediately after training, yet these gains diminished within a month, suggesting the need for structured reinforcement mechanisms to sustain learning outcomes (Masoumian Hosseini et al., 2022). These findings support the notion that gamified interventions should be supplemented with ongoing practice, structured debriefings, and curriculum integration to maximize their long-term impact on student learning (Chang et al., 2022; H. K. Pangandaman et al., 2024; Saastamoinen et al., 2022).

Despite its numerous benefits, the success of gamification in nursing education depends on several factors, including resource

availability, curriculum alignment, and instructor proficiency. Studies suggest that gamified learning requires clear learning objectives, appropriate technological support, and adequate faculty training to be effectively implemented in nursing curricula (Al-Mugheed et al., 2022; Masoumian Hosseini et al., 2022). Some of the challenges identified in the review include high development costs for digital simulations, disparities in student access to game-based tools, and difficulties in assessing long-term retention outcomes (Idrissi et al., 2022; Nasirzade et al., 2024; Padilha et al., 2019).

Another notable limitation is that most gamified interventions targeted novice nursing students, making it difficult to generalize findings to more experienced learners or advanced clinical training settings. Future studies should explore how gamification impacts higher-level competencies and whether it remains effective in professional development settings. Additionally, longitudinal research is needed to assess knowledge retention over extended periods, providing further insights into the sustainability of gamified learning outcomes.

Implications and Limitations

The findings of this systematic review highlight the potential of gamification as an effective pedagogical tool in nursing education. The consistent improvements in knowledge retention, skill development, and student engagement suggest that integrating game-based learning strategies into nursing curricula could enhance both theoretical understanding and clinical competency. The use of digital simulations, virtual reality, and serious games has demonstrated significant benefits in improving students' problem-solving abilities and practical skills, indicating that gamification can serve as a valuable complement to traditional teaching methods.

From a broader perspective, the findings of this study also have implications for policy-making in nursing education. As healthcare institutions increasingly prioritize competency-based education and hands-on training, gamification can serve as a viable instructional strategy to enhance clinical preparedness. Policymakers in nursing education and accreditation bodies should consider incorporating gamified learning methodologies into national nursing curricula to support the development of competent and confident nursing graduates.

Despite the promising findings, this systematic review also revealed several limitations that should be considered when interpreting the results. One major limitation is the variability in study designs and intervention methods. The included studies employed different types of gamified learning strategies, ranging from digital simulations to board games, making it challenging to directly compare results and determine which specific gamification techniques are most effective. Future research should focus on conducting comparative studies that assess the effectiveness of different gamification approaches under standardized conditions.

5. CONCLUSION

This systematic review confirms that gamification enhances both knowledge retention and skill development in nursing education. Across multiple studies, students in gamified learning environments demonstrated higher academic performance, greater engagement, and improved confidence in clinical skill application. The effectiveness of digital simulations, virtual reality interventions, and competitive game-based challenges reinforces gamification as a transformative learning approach in nursing education.

While the findings support the integration of gamification into nursing curricula, further research is necessary to optimize different gamification strategies for varying learning styles, examine its long-term effects, and refine implementation frameworks. Future studies should conduct comparative analyses of different gamified learning models—such as serious games, simulations, and mobile-based applications—to determine the most effective approaches ford knowledge retention and clinical skill acquisition. Despite some challenges in implementation, gamification remains a promising pedagogical tool that fosters active learning, enhances motivation, and strengthens both theoretical and practical competencies among nursing students.

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Conflict of Interest

The authors declare no conflict of interest.

REFERENCES

[1] Abdulkhaled, S. A. J., & Pangandaman, H. (2025). Association Between Computer Literacy and Utilization of Health Information Technology in Nursing Documentation and Plan of Care among Staff Nurses in a Tertiary Hospital [Research]. Journal of Client-Centered Nursing Care, 11(2), 0-0. https://doi.org/10.32598/jccnc.11.2.571.6

[2] Abdulmalik, P. P., & Pangandaman, H. (2024). Leadership Traits of Nurse Managers and Nurse Staff Commitment in the Philippines Hospitals. Indonesian Journal of Health Administration (Jurnal Administrasi Kesehatan Indonesia), 12(1), 49-61. https://doi.org/10.20473/jaki.v12i1.2024.49-61

[3] Al-Hammouri, M. M. (2024). Promoting evidence-based practice in nursing education: the good behavior game as a pedagogical tool for student engagement. Teaching and Learning in Nursing, 19(3), e545-e549. https://doi.org/https://doi.org/10.1016/j.teln.2024.03.011

[4] Al-Mugheed, K., Bayraktar, N., Al-Bsheish, M., AlSyouf, A., Aldhmadi, B. K., Jarrar, M., & Alkhazali, M. (2022). Effectiveness of game-based virtual reality phone application and online education on knowledge, attitude and compliance of standard precautions among nursing students. PLoS One, 17(11), e0275130. https://doi.org/10.1371/journal.pone.0275130

[5] Aljezawi, M., & Albashtawy, M. (2015). Quiz game teaching format versus didactic lectures. Br J Nurs, 24(2), 86, 88-92. https://doi.org/10.12968/bjon.2015.24.2.86

[6] Blanié, A., Amorim, M.-A., & Benhamou, D. (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. BMC Medical Education, 20(1), 53. https://doi.org/10.1186/s12909-020-1939-6

[7] Chang, Y. S., Hu, S. H., Kuo, S. W., Chang, K. M., Kuo, C. L., Nguyen, T. V., & Chuang, Y. H. (2022). Effects of board game play on nursing students' medication knowledge: A randomized controlled trial. Nurse Educ Pract, 63, 103412. https://doi.org/10.1016/j.nepr.2022.103412

[8] Demiray, A., & Keskin Kızıltepe, S. (2022). The Effect of Computer Based Game on Improving Nursing Students' Basic Life Support Application Skills: Experimental Study. 14, 106.

[9] Demirtas, A., Basak, T., Sahin, G., & Sonkaya, M. Ç. (2022). The Serious Game and Integrated Simulator for Cardiopulmonary Resuscitation Training in Nursing Students. Simulation & Gaming, 53(2), 97-110. https://doi.org/10.1177/10468781211073162

[10] Englund, H., & Basler, J. (2021). Bridging the Gap: Use of Educational Gaming to Teach Acid-Base Imbalance Interpretation in Nursing Students. Nurse Educator, 46(3), 192-194. https://doi.org/10.1097/nne.0000000000000886

[11] Erdoğan, Ç., & Turan, T. (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. Comput Inform Nurs, 41(5), 300-308. https://doi.org/10.1097/cin.0000000000000920

[12] Farsi, Z., Yazdani, M., Butler, S., Nezamzadeh, M., & Mirlashari, J. (2021). Comparative Effectiveness of Simulation versus Serious Game for Training Nursing Students in Cardiopulmonary Resuscitation: A Randomized Control Trial. International Journal of Computer Games Technology, 2021(1), 6695077. https://doi.org/https://doi.org/10.1155/2021/6695077

[13] Fernández Alemán, J. L., Carrillo de Gea, J. M., & Rodríguez Mondéjar, J. J. (2011). Effects of competitive computer-assisted learning versus conventional teaching methods on the acquisition and retention of knowledge in medical surgical nursing students. Nurse Educ Today, 31(8), 866-871. https://doi.org/10.1016/j.nedt.2010.12.026

[14] Fijačko, N., Masterson Creber, R., Metličar, Š., Strnad, M., Greif, R., Štiglic, G., & Skok, P. (2024). Effects of a Serious Smartphone Game on Nursing Students' Theoretical Knowledge and Practical Skills in Adult Basic Life Support: Randomized Wait List-Controlled Trial. JMIR Serious Games, 12, e56037. https://doi.org/10.2196/56037

[15] Gutiérrez-Puertas, L., Márquez-Hernández, V. V., Román-López, P., Rodríguez-Arrastia, M. J., Ropero-Padilla, C., & Molina-Torres, G. (2020). Escape Rooms as a Clinical Evaluation Method for Nursing Students. Clinical Simulation in Nursing, 49, 73-80. https://doi.org/https://doi.org/10.1016/j.ecns.2020.05.010

[16] Hu, H., Lai, X., Li, H., & Nyland, J. (2022). Teaching Disaster Evacuation Management Education to Nursing Students Using Virtual Reality Mobile Game-Based Learning. Comput Inform Nurs, 40(10), 705-710. https://doi.org/10.1097/cin.0000000000000856

[17] Idrissi, W., Chemsi, G., Kababi, K., & Radid, M. (2022). The Impact of Serious Game on the Nursing Students' Learning, Behavioral Engagement, and Motivation. International Journal of Emerging Technologies in Learning (iJET), 17, 18-35. https://doi.org/10.3991/ijet.v17i01.26857

[18] Khaledi, A., Ghafouri, R., Anboohi, S. Z., Nasiri, M., & Ta'atizadeh, M. (2024). Comparison of gamification

and role-playing education on nursing students' cardiopulmonary resuscitation self-efficacy. BMC Medical Education, 24(1), 231. https://doi.org/10.1186/s12909-024-05230-7

[19] Kim, H., & Kim, B. (2022). Effects of Situation-Based Flipped Learning and Gamification as Combined Methodologies in Psychiatric Nursing Education: A Quasi-Experimental Study. Healthcare (Basel), 10(4). https://doi.org/10.3390/healthcare10040644

[20] Koivisto, J.-M., Buure, T., Engblom, J., Rosqvist, K., & Haavisto, E. (2024a). Association between game metrics in a simulation game and nursing students' surgical nursing knowledge – a quasi-experimental study. BMC Nursing, 23(1), 16. https://doi.org/10.1186/s12912-023-01668-0

[21] Koivisto, J.-M., Buure, T., Engblom, J., Rosqvist, K., & Haavisto, E. (2024b). The effectiveness of simulation game on nursing students' surgical nursing knowledge—a quasi-experimental study. Teaching and Learning in Nursing, 19(1), e22-e29. https://doi.org/https://doi.org/10.1016/j.teln.2023.08.006

[22] Ma, D., Shi, Y., Zhang, G., & Zhang, J. (2021). Does theme game-based teaching promote better learning about disaster nursing than scenario simulation: A randomized controlled trial. Nurse Educ Today, 103, 104923. https://doi.org/10.1016/j.nedt.2021.104923

[23] Masoumian Hosseini, M., Masoumian Hosseini, T., Qayumi, K., & Baeradeh, N. (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. Arch Acad Emerg Med, 10(1), e77. https://doi.org/10.22037/aaem.v10i1.1739

[24] Mitchell, G., Leonard, L., Carter, G., Santin, O., & Brown Wilson, C. (2021). Evaluation of a 'serious game' on nursing student knowledge and uptake of influenza vaccination. PLoS One, 16(1), e0245389. https://doi.org/10.1371/journal.pone.0245389

[25] Mukattil, N. P. P., Hamdoni K. (2024). Barriers and Strategies in the Implementation of Virtual Learning Modalities Amid COVID-19 among Students in Nursing Schools at Sulu Province, Philippines. Critical Medical and Surgical Nursing Journal (CMSNJ), 13(1), 20-25.

[26] Nasirzade, A., Deldar, K., Froutan, R., & Shakeri, M. T. (2024). Comparison of the effects of burn assessment mission game with feedback lecture on nursing students' knowledge and skills in the burn patients' assessment: a randomized clinical trial. BMC Med Inform Decis Mak, 24(1), 157. https://doi.org/10.1186/s12911-024-02558-4

[27] Padilha, J. M., Machado, P. P., Ribeiro, A., Ramos, J., & Costa, P. (2019). Clinical Virtual Simulation in Nursing Education: Randomized Controlled Trial. J Med Internet Res, 21(3), e11529. https://doi.org/10.2196/11529

[28] Pangandaman, H. (2018). Effects of flipped classroom videos in the return demonstration performance of nursing students. Sch J Appl Sci Res, 1(4), 55-58.

[29] Pangandaman, H. (2023). Challenges Faced by Digital Immigrant Nurse Educators in Adopting Flexible Learning Options During the COVID-19 Pandemic: A Phenomenological Study [Research]. Journal of Client-Centered Nursing Care, 9(4), 309-316. https://doi.org/10.32598/jccnc.9.4.571.2

[30] Pangandaman, H., Mukattil, N., Lambayong, J. H., Abdulhan, M., Hayudini, R., Salve, M., Matumadi, I., Macalaba, S., Kadil, R., & Abolbashar, M. (2024). A systematic review of the effectiveness of flipped classroom approaches in developing clinical skills among nursing students. Journal of Research Development in Nursing and Midwifery (J Res Dev Nurs Midw), 21(1), 5-9.

[31] Pangandaman, H. K., Hayudini, M. A. A., Mai-Alauya, S. A., Macarambon, R. d. R., Macalaba, S. P., Ali, N. A., Mukattil, N. P., Ibrahim, N. J., Arani, R.-A. M., & Ladja, N. I. (2025). Fasting and Bedside Care: Experiences of Student Nurses During Ramadhan in the Clinical Setting. Frontiers in Health Informatics, 14(2), 19-25.

[32] Pangandaman, H. K., Mukattil, N. P., Salve, M. M., Raniza, H. I., Tan, N. F. A., Usman, A., N., Tan, E. C., Salve, M. M., & Mai-Alauya, S. A. (2024). Smartphone As Basic Paraphernalia Of Nursing Students Clinical Exposure: A Scoping Review. Frontiers in Health Informatics, 13(8), 790-799.

[33] Renuka, K., & Ramesh, U. (2019). Effectiveness of Game Learning vs Lecture Method on Knowledge Regarding Biomedical Waste Management among BSc Nursing First-Year Students in Kasturba Gandhi Nursing College at Puducherry, India. Pondicherry Journal of Nursing, 12, 63-67. https://doi.org/10.5005/jp-journals-10084-12128

[34] Saastamoinen, T., Härkänen, M., Vehviläinen-Julkunen, K., & Näslindh-Ylispangar, A. (2022). Impact of 3D

Simulation Game as a Method to Learn Medication Administration Process: Intervention Research for Nursing Students. Clinical Simulation in Nursing, 66, 25-43. https://doi.org/https://doi.org/10.1016/j.ecns.2022.02.005

[35] Samuel, V. M., Llaguno, M. B. B., Mary Beth, M. R., Cabalsa, M. O., & Mahmoud, H. M. (2022). Digital Gamification: An Innovative Pedagogy for Anatomy and Physiology Course Among Medical-Surgical Nursing Students. Assiut Scientific Nursing Journal, 10(28), 1-14. https://doi.org/10.21608/asnj.2022.110919.1282

[36] Sanz-Martos, S., Álvarez-García, C., Álvarez-Nieto, C., López-Medina, I. M., López-Franco, M. D., Fernandez-Martinez, M. E., & Ortega-Donaire, L. (2024). Effectiveness of gamification in nursing degree education. PeerJ, 12, e17167. https://doi.org/10.7717/peerj.17167

[37] Sengul, T., & Kaya, N. (2024). Unlocking Excellence: Improving Nursing Students' Knowledge of Pressure Injury Prevention through an Escape Room Experience. Adv Skin Wound Care, 37(11&12), 1-8. https://doi.org/10.1097/asw.0000000000000228

[38] Smith, S. J., Farra, S., Ulrich, D. L., Hodgson, E., Nicely, S., & Matcham, W. (2016). Learning and Retention Using Virtual Reality in a Decontamination Simulation. Nurs Educ Perspect, 37(4), 210-214. https://doi.org/10.1097/01.Nep.0000000000000035

[39] Taghinejad, H., Mozafari, M., Bazhdan, A., & Vasiee, A. (2024). Investigating the Effect of Online Gamification on Electrocardiogram Interpretation and Self-Directed Learning in Nursing Students. J Adv Med Educ Prof, 12(3), 199-207. https://doi.org/10.30476/jamp.2024.101396.1925

[40] Tang, Y., Gu, R., Zhao, Y., Wang, J., Zhang, Y., Li, Q., Wang, Z., Wang, S., Wei, Q., & Wei, L. (2023). Effectiveness of a Game-Based Mobile Application in Educating Nursing Students on Venous Blood Specimen Collection: A Randomized Controlled Trial. Games Health J, 12(1), 63-72. https://doi.org/10.1089/g4h.2022.0085

[41] Tay Swee Cheng, R., Wegner, D. R., Siong Lim, L., Ting, J. and Ting Ong, S. (2024). Enhancing teaching and learning of evidence-based practice via game-based learning. Asia Pacific Scholar, 9(3), 41-49. https://doi.org/10.29060/taps.2024-9-3/sc3111

[42] Yang, S. Y., & Oh, Y. H. (2022). The effects of neonatal resuscitation gamification program using immersive virtual reality: A quasi-experimental study. Nurse Educ Today, 117, 105464. https://doi.org/10.1016/j.nedt.2022.105464

[43] Zehler, A., & Musallam, E. (2021). Game-Based Learning and Nursing Students' Clinical Judgment in Postpartum Hemorrhage: A Pilot Study. J Nurs Educ, 60(3), 159-164. https://doi.org/10.3928/01484834-20210222-07