### RESEARCH



# Game on or game over? Gamification from 360-degree perspective, perception, confidence, and challenges in simulation based nursing education: mixedmethod study



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#### Abstract

**Background** Gamification has emerged as a transformative approach in nursing education, especially within simulation-based learning environments. It is recognized for enhancing student engagement, knowledge retention, and confidence. Despite its potential, limited research has explored the perceptions and confidence of nurse educators and students, as well as the challenges encountered during its implementation. The study aimed to assess the perceptions and confidence of nurse educators and nursing students towards integrating gamification into simulation-based nursing education, identify implementation barriers, and develop and validate two psychometric tools: the Gamification Perception Assessment Tool and the Nurse Educator Confidence Tool.

**Methods** A convergent mixed-methods design was utilized, involving 115 nurse educators and 317 nursing students from eight nursing institutions in Cairo. Quantitative data were collected using the newly developed tools, which underwent rigorous validation through Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), and reliability testing. Qualitative data were collected via semi-structured questionnaires and interviews with nurse educators and analyzed thematically to explore implementation challenges.

**Results** The overall mean perception score was  $34.8 \pm 8.4$  for nursing students and  $36.3 \pm 7.9$  for nurse educators, with the majority of participants in both groups showing a high perception level (61.7% for educators and 58.9% for students). Nurse educators displayed moderate to high confidence, which was significantly influenced by their experience and prior training. A strong positive correlation (r=0.711, p=0.001) was found between perception and

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confidence. The psychometric tools demonstrated high reliability (Cronbach's α = 0.68–0.85) and model fit. Thematic analysis revealed barriers such as institutional policy gaps, limited IT support, and lack of training.

**Conclusion** Gamification is positively perceived and fosters educator confidence in simulation-based nursing education. However, successful implementation requires institutional support, faculty training, and standardized evaluation tools to overcome existing challenges and optimize educational outcomes. The study provides validated tools and empirical insights into gamification in nursing education.

Clinical trial number Not applicable.

Keywords Educational technology, Nursing education, Simulation training, Gamification, Students

#### Introduction

Developing students' attitudes and skills in both theoretical and practical contexts is a fundamental aim of nursing education [1]. To navigate challenging and dynamic clinical practice settings and deliver individualized, holistic nursing care, nursing students must possess a broad skill set [2]. Important considerations include ensuring nursing students are competent and confident in the clinical practice environment, as well as enhancing patient care outcomes [3]. Combining gamification and digital technologies into nursing education has become a transformative strategy with numerous advantages, but it also presents special challenges [4]. A relatively recent trend, gamification is the application of game elements to nongame environments to engage audiences and infuse a little pleasure into daily routines, apart from producing motivating and cognitive benefits [5]. Gamification of education is a tactic for increasing involvement by including gaming components in an educational environment [6]. Gamification, sometimes known as gameful design, is the deliberate application of game design ideas, mechanisms, and features into non-game situations [7].

By incorporating game aspects, educational games aim to enhance the learning process [8]. Since video games appear to improve several outcomes, utilizing them as a means of delivering cognitive training may also be beneficial. Different learning styles can be accommodated, and education can be made more entertaining by utilizing board games, escape rooms, digital simulations, and virtual reality [9]. These formats offer engaging and realistic learning experiences that enable students to grasp complex nursing concepts effectively [10]. For example, research has shown that gamified platforms, such as Kahoot and Kaizen, boost student engagement and excitement, making complex ideas more approachable and enjoyable [11].

Gamification approaches in nursing education have demonstrated considerable efficacy in improving students' competencies and understanding [12]. It has been associated with enhanced decision-making, critical thinking, and communication skills, which are vital for clinical practice [13, 14]. Through the incorporation of game-based learning methodologies, educators can enhance engagement, motivation, and memory of intricate nursing topics [15]. Implementing team-based competitions fosters collaboration among students, hence boosting critical thinking and problem-solving abilities [16]. Competitions that feature knowledge-based inquiries and practical skills have demonstrated a significant improvement in post-intervention knowledge and confidence [17, 18].

Another significant benefit of gamification is its ability to improve knowledge retention and provide personalized learning pathways tailored to individual needs. Unlike traditional rote memorization methods, gamified education uses interactive tools such as quizzes, simulations, and case-based scenarios that promote active participation and long-term retention of information [19]. Furthermore, gamification offers flexibility by adapting to different learning paces and styles, allowing students to progress through challenges at their own pace while receiving instant feedback on their performance [20]. Gamification also simplifies complex topics by breaking them into manageable tasks or quests, making complex concepts more accessible and engaging. By combining these benefits with streamlined training processes and realistic simulations, gamification enhances the educational experience and equips nursing students with the confidence and competence necessary for professional success [21].

Simulation-based nursing education integrates theoretical knowledge with practical application, creating an environment in which students actively participate in authentic clinical scenarios [22]. Simulation programs, simulated patients, and serious games are innovative pedagogical methods for imparting skills in nursing education, which educators favor in health education [23]. Acquiring practical abilities in laboratory applications is crucial for students to develop adequate knowledge, competencies, and self-assurance before commencing clinical practice. Simulation-based education offers a secure environment for students to develop and enhance their clinical abilities without jeopardizing patient safety [24, 25]. Nurse educators develop students' psychomotor skill competencies in the laboratory using manikin simulators, skill videos, or trainer demonstrations [26].

Nursing students often need to acquire numerous skills concurrently within a brief timeframe and have limited access to laboratory settings for skill practice [27]. Nevertheless, due to technological advancements, student expectations, and the ongoing evolution of knowledge in the contemporary landscape, traditional methods employed in laboratory applications have heightened the demand for supplementary teaching strategies and resources to augment knowledge and skills [4, 28]. Consequently, nurse educators must employ innovative pedagogical methods that spark students' interest [29].

Learning outcomes in nursing education can be significantly improved by striking a balance between gamification techniques and traditional teaching methods. While gamification introduces interactive components that foster motivation and critical thinking, traditional approaches often lack engagement [9]. By combining these strategies, teachers can create a more dynamic learning environment that meets the evolving needs of nursing students [30]. Vital thinking, decision-making, and problem-solving skills are essential for nursing practice and can be enhanced by gamified approaches [31].

Although gamification platforms offer various advantages, some educators argue that traditional approaches remain significant, particularly in the acquisition of core knowledge. Integrating both methodologies may enhance nursing education results [9]. Although gamification can enhance engagement and learning outcomes, its optimal integration requires a meticulous evaluation of multiple elements [32]. Numerous educators may be familiar with traditional teaching methods, which can lead to a reluctance to adopt gamified strategies [33]. A further disadvantage is the expense associated with establishing and sustaining simulation facilities, especially those utilizing modern technologies such as virtual reality [34].

Often time-consuming and resource-intensive, educators need further training to properly design and use gamified content [29]. It can be challenging to ensure that gamified approaches align with accepted learning goals and educational norms. It is quite challenging to incorporate gamification into current courses without compromising important nursing principles [10]. Students also have different preferences for learning styles; therefore, it is challenging to design a one-size-fits-all gamified experience. Nonetheless, continuous assessment and adaptation are necessary to meet the diverse needs of both teachers and students [35].

The integration of gamification in simulation-based nursing education is increasingly favored due to its capacity to enhance learning outcomes, motivation, and student engagement. Nonetheless, despite this emerging tendency, a considerable deficiency exists in work specifically examining the perspectives of students and nurse educators regarding the integration of this approach into the educational context. Furthermore, a study has been conducted on the confidence of nurse educators and the challenges they face while implementing gamification approaches in simulation environments. This study is indispensable in bridging the gap by providing a comprehensive understanding of the perspectives of diverse stakeholders, which can inform the development of more effective, evidence-based strategies for gamified nursing education. The scarcity of existing literature in this specific domain and context highlights the need for targeted studies to promote innovation and best practices in nursing pedagogy.

#### Methods

#### **Research aim**

This study aims to assess the perceptions and confidence of nurse educators and nursing students regarding the integration of gamification into simulation-based nursing education, as well as to identify the most significant barriers to its implementation. Additionally, the study seeks to develop, validate, and psychometrically examine two assessment tools: the Gamification Perception Assessment Tool and the Nurse Educator Confidence Tool, using both exploratory and confirmatory factor analysis.

### Research design, sample, and sampling *Design*

This study employed convergent mixed-methods research to comprehensively examine the integration of gamification within simulation-based nurse education. The quantitative and qualitative data were collected simultaneously to assess the perceptions and confidence levels of nurse educators and students, and to identify the difficulties associated with implementing gamification. The quantitative phase involved the development and piloting of two assessment tools: the Gamification Perception Assessment tool and the Nurse Educator Confidence tool. These tools were evaluated through Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), and reliability testing. The qualitative phase employed a semi-structured questionnaire (see Supplementary File 1) developed specifically for this study to gather in-depth insights from nurse educators regarding organizational, technological, and pedagogical concerns associated with the use of gamified methods in simulation settings. Thematic analysis was employed to identify recurring patterns and barriers. This study design enabled the combination of numerical data with rich, contextual stories to gain a 360-degree view of the effectiveness, usability, and feasibility of gamification in nursing education.

#### Sampling procedure and data collection

To achieve adequate coverage of all the nursing institutions located in Cairo, a two-stage stratified random sampling technique was implemented. In the initial step, purposive sampling was conducted to select eight nursing institutions that were offering courses in simulationbased nursing education. These institutions spanned across five geographic areas in Cairo, which included the Northern, Southern, Eastern, Western, and Central regions of Cairo. From the selected institutions, nonprobability convenience sampling was applied to nurse educators and nursing students who met the eligibility criteria. With regard to the nurse educators, the inclusion criteria stipulated having at least three years of experience in teaching using simulation-based methodologies. Exclusion criteria were applicable to educators who had less than three years of experience with no simulation exposure. As for the students, eligibility criteria included active registration in undergraduate nursing programs and participation in courses featuring learning by simulation modules.

A total of 140 nurse educators and 372 nursing students were invited to participate in the study. Of these, 115 nurse educators (response rate: 82.1%) and 348 nursing students (response rate: 93.5%) agreed to participate and completed the study requirements. The sample size was determined using Cochran's formula, assuming an estimated proportion of 0.5 (for maximum variability), a power of 0.90, a significance level of 0.05, and a z-value of 1.96 corresponding to a 95% confidence level [36]. To account for potential non-responses or incomplete data, a 10% buffer was included in the sample size calculation. Following data cleaning and revision, 31 students' entries were excluded due to missing or incomplete data, yielding a final analyzed sample size of 317 students and 115 nurse educators.

Online and field surveys were conducted. To maintain anonymity, responses to the tools were collected without personally identifiable data (e.g., names or employee IDs). Participants were assigned a unique identification code that linked their responses to their demographic data, ensuring anonymity without revealing their identity. Access to this coded data was restricted to members of the research team, who kept it safe in a passwordprotected database. Eligible participants were invited via email and in-person recruitment, with the purpose of the study clearly explained. The questionnaire was distributed both online and in person, and completing the survey was taken as an indication of participants' consent. The estimated completion time was 15–20 min.

#### Data collection procedures *Measurements*

Three instruments were developed and utilized in this study to assess perceptions, confidence levels, and challenges related to gamification in simulation-based nursing education.

The Gamification Perception Assessment Tool is designed to evaluate nurse educators' perceptions of incorporating gamification into simulation-based nursing education. The tool measures perceptions across three key dimensions: Engagement and Motivation, Knowledge Retention and Learning Outcomes, and Usability and Implementation. It consists of a total of nine items, with three items under each of the three dimensions. Respondents are asked to indicate their level of agreement with each statement using a 5-point Likert scale, where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5=Strongly Agree. The researcher developed this tool (see Supplementary File 1) to measure the attitudes of nurse educators and nursing students towards gamification being introduced into simulation-based learning. It was based on a comprehensive review of literature relevant to the subject [37, 38]. The sources provided theoretical frameworks and empirical findings to inform the determination of overarching constructs relevant to the context of gamification in nursing education.

To ensure content validity, the initial pool of items was developed based on themes and domains that are most frequently reported in the literature, such as learner interest, motivation, knowledge retention, and difficulties in applying the concepts in practice. The first draft of the tool was reviewed by an expert panel of nursing education and instructional design specialists to determine its applicability, clarity, and completeness. Input from this expert panel led to several revisions of the wording and structure of items, all aimed at facilitating alignment with real-world classroom experiences.

Under the Engagement & Motivation dimension, participants assess whether gamification enhances students' participation in simulation-based learning, increases motivation to participate, and enhances their enjoyment of the learning process. The Knowledge Retention & Learning Outcomes dimension examines observations of gamification's impact on knowledge retention, critical thinking, clinical decision-making, and performance compared to non-gamified practice. Lastly, the Usability & Implementation dimension measures how convenient gamified simulations are to integrate into nursing education, if they are easy to teach within nursing concepts, and overall, if game elements can be effectively employed in institutional settings.

Scores for each dimension range from 3 to 15, and the overall score ranges from 9 to 45. Interpretation is categorized as follows: for each dimension, a score of 9–15

indicates a high perception, 6–8 indicates a moderate perception, and a score of less than 6 indicates a low perception. For the total score, 27–45 indicates a high perception, 18–26 suggests a moderate perception, and a score of less than 18 indicates a low perception of gamification in simulation-based nursing education.

#### Nurse educator confidence tool

The Confidence Assessment Tool was developed specifically for this study (see Supplementary File 1) to assess nurse educators' confidence in using gamification strategies within simulation-based nursing education. The tool is structured to measure confidence across three essential dimensions: Design and Implementation, Evaluation and Assessment, and Technical and Resource Competence. Each dimension represents a core area of competency needed to effectively integrate gamified methodologies into nursing education settings.

The Design & Implementation construct assesses teachers' self-efficacy in developing and applying gamified approaches in simulation-based activities. Items on this scale assess competence in designing gamified contexts, using gamification techniques in a controlled learning environment, and adapting traditional simulations to gamified modes. The construct reflects the fundamental expertise of creating instructional activities with ingame mechanics in an effective and pedagogically sound manner.

The Evaluation and Assessment component measures the teacher's self-efficacy in assessing the outcomes of gamified learning sessions. It contains items measuring their ability to assess student performance in gamified simulations, recognize the effectiveness of gamification on learning outcomes, and collect and analyze relevant feedback. This component ensures that teachers not only implement gamification but also understand its impact on learning processes, allowing them to make informed improvements.

The third dimension, Technical and Resource Competence, reflects the teacher's ability to feel safe using the technological tools and resources required in gamified instruction. Items assess whether they feel safe using computer-based tools to conduct simulation exercises, how they can support peers or other colleagues in implementing gamification processes, and whether they are inclined to advocate for gamification enactment within schools. The dimension reflects the teacher's ability to facilitate gamification activities both technologically and strategically within the broader teaching environment.

Every item in the tool is scored on a 5-point Likert scale, with 1 indicating "Strongly Disagree" and 5 indicating "Strongly Agree." There are a total of nine items and three items per dimension. Scores on every dimension range from 3 to 15, and the total score ranges from 9 to

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45. Scores are interpreted as follows: on every dimension, a score of 9–15 indicates high confidence, a score of 6–8 represents moderate confidence, and a score of 5 or lower indicates low confidence. Similarly, for the overall score, a range of 27–45 indicates high confidence, 18–26 indicates moderate confidence, and a score of less than 18 indicates low confidence in utilizing gamification within simulation-based instruction.

The Nurse Educator Confidence was developed based on an extensive literature review of teaching design, instructor readiness, and gamification usage [39, 40]. These provided theoretical underpinnings for identifying the confidence domains required for integrating gamification into simulation pedagogy. This was preceded by the development of items and expert review through an expert panel of nurse educators and instructional design professionals. Feedback informed the revision process, enabling content to be aligned with practice, relevant, and clear.

Pilot testing demonstrated strong internal consistency across dimensions, with Cronbach's alpha values ranging from 0.80 to 0.86. Furthermore, exploratory and confirmatory factor analyses confirmed the structural validity of the tool, establishing its appropriateness for evaluating educator confidence in this context.

#### **Challenges semi-structured questionnaire**

The Semi-Structured Questionnaire for Challenges is a qualitative questionnaire developed by the researcher (see Supplementary File 1) to identify the challenges and hindrances that nurse educators encounter during the implementation of gamification in simulation-based nursing education. This tool was developed based on a comprehensive review of previous literature on gamification adoption and instructional innovation, with particular focus on common obstacles faced in academic and institutional environments [41]. It is designed to obtain rich, detailed responses that capture the real challenges experienced by nurse educators.

The questionnaire format is grounded on three core thematic areas: institutional support and policy constraints, technological constraints, and faculty support and training requirements. These themes are addressed through a set of open-ended questions that invite participants to share their individual experiences, observations, and perceived gaps. Respondents are invited to respond to the open-ended questions in writing, giving rich descriptions and insights into the specific challenges they face. Qualitative data derived using this tool are analyzed through thematic analysis with open coding, which is utilized to identify emerging categories and trends. The themes are synthesized to target predominant barriers and inform the development of targeted interventions. Finally, the tool is anticipated to yield actionable findings that will inform the design of support systems, training programs, and policies at institutions, aiding the effective integration of gamification in simulation-based nursing education.

#### Fieldwork

#### Online data collection procedures

To optimally capture data with a large sample size, the study used face-to-face and online approaches. Secure online survey platforms were utilized during the quantitative phase to administer two tools, the Gamification Perception Assessment Tool and the Nurse Educator Confidence Tool, which were distributed to nurse educators. The Perception Tool was also distributed to students participating in simulation courses. The study was conducted between December 2024 and March 2025. Surveys for nurse educators were shared via institutional email, academic networks, and other contacts with simulation unit coordinators. All educators, along with ethical assurances and study details, were sent invitations complete with links to the surveys. Data security was provided by the Google Forms survey, which was designed to accept responses on a one-per-person basis, was encrypted, and ensured pseudonymization. Consent pages were provided, and participants were sent weekly reminders for three weeks to enhance response rates. Nursing students were assured anonymity, and no recognizable data would be collected, such as name and ID, while responding to the survey. The consent form made it clear that it was entirely voluntary to participate. Responses were protected in a secure database, while incomplete or invalid responses were deleted during the data cleansing process. Automated reminders, as well as form validation guaranteeing data completeness, capped the point of collection.

#### Qualitative data collection for challenges

For the qualitative phase, data regarding the challenges faced by nurse educators, particularly in the context of gamification utilization, were collected through openended survey questions and semi-structured interviews. The qualitative components were designed to provide a deeper insight into real-world challenges that educators face in simulation-based learning. Participants for the qualitative phase were selected using purposive sampling to ensure a range of perspectives from educators across different institutions and positions. Interviews were conducted either face-to-face or via Zoom, depending on the participant's preference and logistical ease. The interviews lasted approximately 30 to 45 min each and were audio-recorded with participants' consent, enabling accurate transcription and analysis. All qualitative data were transcribed verbatim and analyzed by thematic analysis. Open coding was employed to identify the recurring categories and themes.

#### Statistical analysis

#### Quantitative analysis

The statistical analysis for this study was conducted using IBM SPSS Statistics, version 26.0, employing both univariate and multivariate methods to investigate the relationships between nurse leaders' perceptions of financial management practices and patient care quality and outcomes. Mean and frequency distributions were calculated to evaluate perceptions across various dimensions. The reliability and internal consistency of the questionnaire were assessed using Cronbach's alpha. Additionally, t-tests and Analysis of Variance (ANOVA) were performed to compare group means and determine significant differences based on sociodemographic characteristics. Bartlett's test of sphericity was performed to determine the adequacy of the data for factor analysis, yielding a significant result (p < 0.001). Additionally, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was calculated and surpassed the minimum acceptable value of 0.7, confirming the suitability of the dataset for factor analysis. The internal consistency of the tool was assessed using Cronbach's alpha to ensure its reliability within the study sample. Factor analysis is a statistical technique to identify the underlying structure of a dataset. A significance threshold of p < 0.05 was used to determine statistical significance.

#### **Qualitative analysis**

The qualitative data in this study were analyzed using thematic analysis, following a step-by-step process to ensure a structured and systematic approach. First, interview transcripts and open-ended survey responses were transcribed and reviewed for familiarization. An inductive coding approach was used to assign codes to meaningful text segments, identifying key themes. These themes were refined, reviewed, and categorized under the study's financial management domains. Researchers ensured accuracy by cross-checking themes against original transcripts and resolving discrepancies through consensus. Each theme was clearly defined, with representative participant quotes selected to illustrate key findings.

## Factor analysis results: Gamification perception and nurse educator confidence assessment tools

Data Suitability for Factor Analysis by using Bartlett's Test of Sphericity and the Kaiser-Meyer-Olkin (KMO). The KMO measure of sampling adequacy for the used tools was 0.78 and 0.79, respectively. Surpasses the minimum threshold of 0.70, indicating sufficient sample size for factor analysis. Additionally, the Bartlett's Test of Sphericity yielded a significant result (p < 0.001),

Item	Gamification perception assessment		Nurse educator confidence				
	Factor 1 (Engage- ment & Motivation)	Factor 2 (Knowledge & Learning)	Factor 3 (Usability & Implementation)	Factor 1 (Tech- nical & Design Confidence)	Factor 2 (evaluation & assessment)	Factor3 (technical & resource competence)	tor load- ings
PQ1	0.712	-	-	-	-	-	0.712
PQ2	0.815	-	-	-	-	-	0.815
PQ3	0.768	-	-	-	-	-	0.768
PQ4	-	0.802	-	-	-	-	0.802
PQ5	-	0.764	-	-	-	-	0.764
PQ6	-	0.712	-	-	-	-	0.712
PQ7	-	-	0.758	-	-	-	0.758
PQ8	-	-	0.826	-	-	-	0.826
PQ9	-	-	0.741	-	-	-	0.741
CQ1	-	-	-	0.586	-	-	0.586
CQ2	-	-	-	0.667	-	-	0.667
CQ3	-	-	-	0.553	-	-	0.553
CQ4	-	-	-	-	0.708	-	0.708
CQ5	-	-	-	-	0.713	-	0.713
CQ6	-	-	-	-	0.738	-	0.738
CQ7	-	-	-	-	-	0.748	0.748
CQ8	-	-	-	-	-	0.455	0.455
CQ9	-	-	-	-	-	0.698	0.698

Table 1 Exploratory factor loadings for the gamification perception assessment tool and the nurse educator confidence tool

**Table 2** Internal consistency and test-retest reliability

Factor	Cronbach's alpha	Spearman correlation (test-retest)
Engagement & Motivation	0.85	0.86
Knowledge & Learning	0.79	0.81
Usability & Implementation	0.82	0.80
Technical & Design Confidence	0.68	0.79
Evaluation & assessment	0.72	0.71
Technical & resource competence	0.78	0.80

confirming the presence of meaningful intercorrelations among the items. These results confirm the dataset's suitability for factor analysis.

#### **Exploratory factor analysis (EFA)**

The Exploratory Factor Analysis, as shown in Table 1, confirmed six distinct factors, each corresponding to a key dimension of gamification perception and confidence. All factor loadings exceeded the acceptable threshold of 0.40, indicating strong associations between items and their respective factors. The results validate the intended structure of the tool and confirm its effectiveness in measuring nurse educators' perceptions accurately.

#### **Reliability analysis**

Cronbach's Alpha values reflect the internal consistency of each factor, with values ranging from 0.68 to 0.85, indicating acceptable to high reliability. The Engagement & Motivation subscale demonstrated the highest internal consistency ( $\alpha = 0.85$ ), while Technical & Design Confidence showed the lowest ( $\alpha = 0.68$ ), yet still within acceptable limits for exploratory research. Spearman correlation coefficients for test-retest reliability ranged from 0.71 to 0.86, confirming temporal stability of the instruments over time; see Table 2.

#### **Confirmatory factor analysis (CFA)**

The confirmatory factor analysis results for the perception assessment tool indicate that the six-factor model provides an excellent fit for the data. The  $\chi^2$ /df value of 2.301 falls within the acceptable range (<3.0), and the Comparative Fit Index (CFI=0.919) confirms strong model alignment. Furthermore, the RMSEA (0.049) and RMR (0.041) values fall well within recommended thresholds, verifying the tool's structural validity. For the nurse educator's confidence, the  $\chi^2$ /df value of 2.220 falls within the acceptable range (<3.0), and the Comparative Fit Index (CFI=0.919) confirms strong model alignment. Furthermore, the RMSEA (0.093) are shown in Table 3.

#### Results

Table 4 presents the sociodemographic characteristics of nurse educators (n = 115) and mean scores of their perceptions and confidence regarding gamification. There were no statistically significant differences observed by gender, although female educators had slightly higher mean perception ( $34.1 \pm 4.8$ ) and confidence scores

 Table 3
 Confirmatory factor analysis fit indices for the gamification perception assessment tool and nurse educator confidence tool

Fit indices	Gamification perce	ption assessment	Nurse educator confidence		
	Six-factor model	Acceptable range	Six-factor model	Acceptable range	
x²/df	2.301	< 3.0	2.220	< 3.0	
Comparative Fit Index (CFI)	0.915	> 0.90	0.919	> 0.90	
Goodness of Fit Index (GFI)	0.872	> 0.85	0.808	> 0.85	
Adjusted GFI (AGFI)	0.839	>0.80	0.801	> 0.80	
Root Mean Square Error of Approximation (RMSEA)	0.049	< 0.06	0.037	< 0.06	
Root Mean Square Residual (RMR)	0.041	< 0.05	0.039	< 0.05	

Table 4	Sociodemogra	ohic chara	cteristics of r	nurse educators	(n = 115)
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Sociodemographic	n	(%)	Nurse educators' per-	Р	Nurse educator confi-	Р
Variables			ception Mean±SD		dence mean ± SD	
Gender						
Male	38	33.0%	$32.4 \pm 5.2$	0.214	$30.8 \pm 5.6$	0.101
Female	77	67.0%	$34.1 \pm 4.8$		33.2±5.1	
Age						
Less than 30 years.	16	13.9%	$26.5 \pm 4.6$	0.022*	$25.9 \pm 4.8$	0.048*
31–35 years.	41	35.7%	$30.8 \pm 5.3$		$30.4 \pm 5.4$	
36–40 years.	30	26.1%	$32.1 \pm 5.0$		31.7±5.2	
More than 40 years	28	24.3%	34.6±4.2		33.9±4.6	
Highest Nursing Degree Earned	ł					
Master of Science in Nursing (MSN)	78	67.8%	33.2±5.1	0.045*	32.8±5.3	0.029*
Nursing PhD.	37	32.2%	$35.4 \pm 4.7$		$35.1 \pm 4.8$	
Years of Experience						
3–5 years	80	69.6%	$29.8 \pm 5.4$	< 0.001	$28.5 \pm 5.7$	< 0.001
6–10 years	13	11.3%	$33.7 \pm 4.9$		32.6±5.2	
11–15 years.	11	9.6%	$34.3 \pm 4.5$		33.8±4.9	
Over 15 years.	11	9.6%	$36.2 \pm 4.0$		35.9±4.3	
Receiving Training on gamificat	ion					
Yes	54	47.0%	$34.5 \pm 4.8$	< 0.001	34.2±5.0	< 0.001
No	61	53.0%	$28.9 \pm 5.2$		27.8±5.6	

SD: Standard Deviation

**Table 5** Sociodemographic characteristics of nursing students (n = 317)

(				
Sociodemographic Variables	n	(%)	Students' Perception Mean±SD	P value
Gender				
Male	110	34.7%	31.5±5.0	0.166
Female	207	65.3%	33.2±4.8	
Years of Study				
Year 1	80	25.2%	$30.0 \pm 5.5$	< 0.001
Year 2	100	31.5%	32.8±4.9	
Year 3	90	28.4%	34.2±4.7	
Year 4	47	14.8%	35.0±4.5	

SD: Standard Deviation

 $(33.2 \pm 5.1)$  than males  $(32.4 \pm 5.2 \text{ and } 30.8 \pm 5.6, \text{ respectively})$ . Age was a significant factor influencing both perception (p = 0.022) and confidence (p = 0.048), with older educators (over 40 years) reporting the highest scores in both domains. Educational attainment was also significantly associated with perception (p = 0.045)

and confidence (p = 0.029). Nurse educators with a PhD in Nursing demonstrated higher levels of both perception ( $35.4 \pm 4.7$ ) and confidence ( $35.1 \pm 4.8$ ) compared to those holding a master's degree. Similarly, years of teaching experience had a highly significant effect (p < 0.001) on perception and confidence scores. Educators who received training had a highly significant relation with their perception and confidence at a p-value < 0.001.

Table 5 presents that the majority of students were female (65.3%), with males comprising 34.7% of the sample. Although female students had a slightly higher mean perception score  $(33.2 \pm 4.8)$  compared to males  $(31.5 \pm 5.0)$ , the difference was not statistically significant (p = 0.166). While there was a highly significant difference in students' perception scores across academic years (p < 0.001).

Table 6 presents that the mean overall perception score was  $34.8 \pm 8.4$  for nursing students and  $36.3 \pm 7.9$  for nurse educators, with the majority of participants in both groups demonstrating a high perception level

Mean ScoreLow (<40%)	Nurs	se educator	( <i>n</i> =115	_					Nursing stude	nts (n = 317)					
Mean±SD.         n.         %         n.         %         n.         %         m.         %         m.	Mear	in Score	Low (<	< 40%)	Mode (40-<	rate 50%)	High (≥60%	(6	Mean Score	Low (< 40	(%	Modé (40-⊲	erate <60%)	High (≥60%	(9
Overall Gamification Perception Level $36.3 \pm 7.9$ $18$ $15.7$ $26$ $22.6$ $71$ $61.7$ $34.$ Engagement & Motivation $12.9 \pm 3.1$ $17$ $14.8$ $20$ $17.4$ $78$ $67.8$ $12.$ Knowledge & Learning Outcomes $12.1 \pm 2.9$ $25$ $21.7$ $18$ $15.7$ $72$ $62.6$ $11.$ Usability & Implementation $11.3 \pm 3.3$ $16$ $13.9$ $34$ $29.6$ $65$ $56.5$ $10$ Overall Nurse Educator Confidence $36.7 \pm 5.1$ $24$ $20.9$ $21$ $18.3$ $70$ $60.8$ Technical & Design Confidence $13.2 \pm 2.7$ $16$ $13.9$ $19$ $16.5$ $80$ $69.6$ Evaluation & assessment $12.6 \pm 1.9$ $20$ $17.4$ $20$ $17.4$ $75$ $65.2$	Mean	in±SD.	ċ	%	ċ	%	ċ	%	Mean±SD.	ċ	%	ċ	%	ċ	%
Engagement & Motivation       12.9±3.1       17       14.8       20       17.4       78       67.8       12.         Knowledge & Learning Outcomes       12.1±2.9       25       21.7       18       15.7       72       62.6       11.         Usability & Implementation       11.3±3.3       16       13.9       34       29.6       65       56.5       10.         Overall Nurse Educator Confidence Level       36.7±5.1       24       20.9       21       18.3       70       60.8         Technical & Design Confidence       13.2±2.7       16       13.9       21       18.3       70       60.8         Evaluation & assessment       12.6±1.9       20       17.4       20       17.4       75       65.2	ation Perception Level 36.3	± 7.9	18	15.7	26	22.6	71	61.7	34.8 ± 8.4	47	14.8	83	26.2	187	58.9
Knowledge & Learning Outcomes $12.1\pm2.9$ $25$ $21.7$ $18$ $15.7$ $72$ $62.6$ $11.$ Usability & Implementation $11.3\pm3.3$ $16$ $13.9$ $34$ $29.6$ $65$ $56.5$ $10.$ Overall Nurse Educator Confidence Level $36.7\pm5.1$ $24$ $20.9$ $21$ $18.3$ $70$ $60.8$ Technical & Design Confidence $13.2\pm2.7$ $16$ $13.9$ $19$ $16.5$ $80$ $69.6$ Evaluation & assessment $12.6\pm1.9$ $20$ $17.4$ $20$ $17.4$ $75$ $65.2$	Aotivation 12.9 -	± 3.1	17	14.8	20	17.4	78	67.8	12.3 ± 3.4	35	11	80	25.2	202	63.7
Usability & Implementation $11.3 \pm 3.3$ 16         13.9         34         29.6         65         56.5         10.           Overall Nurse Educator Confidence Level $36.7 \pm 5.1$ $24$ $20.9$ $21$ $18.3$ $70$ $60.8$ Technical & Design Confidence $13.2 \pm 2.7$ 16 $13.9$ 19 $16.5$ $80$ $69.6$ Evaluation & assessment $12.6 \pm 1.9$ $20$ $17.4$ $20$ $17.4$ $75$ $65.2$	arning Outcomes 12.1 =	± 2.9	25	21.7	18	15.7	72	62.6	$11.8 \pm 3.5$	54	17	70	22.1	193	60.8
Overall Nurse Educator Confidence Level $36.7 \pm 5.1$ $24$ $20.9$ $21$ $18.3$ $70$ $60.8$ Technical & Design Confidence $13.2 \pm 2.7$ $16$ $13.9$ $19$ $16.5$ $80$ $69.6$ Evaluation & assessment $12.6 \pm 1.9$ $20$ $17.4$ $20$ $17.4$ $75$ $65.2$	mentation 11.3 -	± 3.3	16	13.9	34	29.6	65	56.5	$10.7 \pm 3.2$	81	25.6	65	20.5	171	53.9
Technical & Design Confidence         13.2 ± 2.7         16         13.9         19         16.5         80         69.6           Evaluation & assessment         12.6 ± 1.9         20         17.4         20         17.4         75         65.2	ducator Confidence Level 36.7 =	±5.1	24	20.9	21	18.3	70	60.8							
Evaluation & assessment 12.6 ± 1.9 20 17.4 20 17.4 75 65.2	gn Confidence 13.2 -	± 2.7	16	13.9	19	16.5	80	69.6							
	essment 12.6 -	± 1.9	20	17.4	20	17.4	75	65.2							
lechnical & resource competence 10.9±3.5 29 25.2 18 15.7 68 59.1	urce competence 10.9 =	± 3.5	29	25.2	18	15.7	68	59.1							

Table 7	Correlation	between	nurse	educators'	gamification
perception	on and their	confiden	ce (n=	= 115)	

Nurse educators' gamification perception	Nurse educator confidence
r	0.711
р	0.001
r Dearson coefficient	

r: Pearson coefficient

\*: Statistically significant at  $p \le 0.05$ 

(61.7% and 58.9%, respectively). Across sub-dimensions, Engagement & Motivation received the highest mean scores among both educators  $(12.9\pm3.1)$  and students  $(12.3\pm3.4)$ , with over 63% of them having high perception. Also, the mean overall confidence score for nurse educators was  $36.7\pm5.1$ , with 60.8% reporting high confidence. Among the confidence subscales, Technical & Design Confidence had the highest mean  $(13.2\pm2.7)$ , followed by Evaluation & Assessment  $(12.6\pm1.9)$  and Technical & Resource Competence  $(10.9\pm3.5)$ .

Table 7 displays that there was a strong positive correlation between Nurse Educators' Gamification Perception and Nurse Educator *Confidence* (r = 0.711, p = 0.001).

Table 8 presents a thematic analysis of the key challenges faced by nurse educators in integrating gamification into simulation-based education. The findings reveal several barriers that hinder the successful adoption of gamification strategies, including institutional, technological, and pedagogical factors.

One of the most significant challenges identified is the lack of institutional support and policy limitations, which cause educators to struggle with unclear guidelines and administrative barriers. Many respondents reported that securing approval and resources for gamification implementation is complex without formal policies or structured institutional backing. Additionally, technological barriers emerged as a significant concern, with educators citing outdated systems and insufficient IT support as key obstacles preventing seamless gamification integration.

Another prominent issue is faculty and student resistance, with some faculty members preferring traditional teaching methods over gamified approaches. Educators also noted that students sometimes struggle to adapt to game-based learning environments, making the transition to gamification challenging. Furthermore, evaluation challenges were frequently highlighted, as many educators found it difficult to measure the effectiveness of gamification in improving student engagement and learning outcomes due to the absence of standardized assessment tools.

Training and resource needs were emphasized as a crucial factor affecting gamification adoption. Educators reported that a lack of structured training programs and insufficient access to gamification tools hinder their ability to confidently implement gamified learning strategies.

Та	ble 8	<b>B</b> (	Themati	c analysis	s of nurse ea	ducators'	gamification	challenges
							0	

Theme	Unit of meaning	Description	Illustrative quotes
Institutional Support and Policy Limitations	Lack of institutional support hinders the implementation of gamification.	Educators struggle to integrate gamification due to insufficient institutional policies and administrative restrictions.	"There's no clear institutional policy on gamification, so we don't get the support we need." (P3) "Administrative approval processes make it difficult to introduce new teaching methods." (P7)
Technological Barriers	Outdated technology and a lack of IT support hinder the integration of gamification.	Technical infrastructure challenges, outdated systems, and a lack of IT support prevent seamless integration of gamified tools.	"The systems we have aren't compatible with gami- fied learning." (P5) "Lack of IT support makes troubleshooting issues a challenge." (P11)
Faculty and Stu- dent Resistance	Faculty hesitancy and student adaptation difficulties hinder the adoption process.	Faculty members are reluctant to change traditional teaching methods, while students may find game-based learning unfamiliar.	"Some faculty members don't see the value in gami- fication and prefer traditional teaching." (P6) "Students sometimes find it difficult to adjust to game-based learning activities." (P9)
Evaluation Challenges	Challenges in Evaluating the Effectiveness of Gamified Learning.	Educators face difficulties in objectively measuring the impact of gamification on student learning and engagement.	"There's no clear way to measure how effective gamification is in improving learning outcomes." (P4) "We need standardized tools to assess engagement and retention." (P12)
Training and Resource Needs	Limited training opportuni- ties and lack of access to gamification tools.	Without structured training programs and access to gamification tools, educators lack the confidence and resources to implement gamified learning effectively.	"Without proper training, we don't know how to ef- fectively integrate gamification into our lessons." (P2) "There aren't enough resources or guidelines to help us implement this approach." (P8)

Without proper professional development opportunities, many educators feel unprepared to effectively integrate gamification.

These findings suggest that institutional, technological, and pedagogical barriers significantly impact the integration of gamification in nursing education. Addressing these challenges requires the development of clear institutional policies, improved technological infrastructure, faculty training programs, and standardized evaluation frameworks. By providing structured support, institutions can enhance educators' confidence and ability to implement gamification effectively, leading to improved student engagement and learning outcomes.

#### Discussion

This study presents the findings from a mixed-methods study that examines the perceptions of nurse educators and students regarding the incorporation of gamification in simulation-based education, as well as assesses nurse educators' confidence and challenges in embracing gamification within this educational framework. Nurse educators' and students' perceptions were reflected in engagement and motivation, knowledge retention, and learning outcomes, as well as usability and implementation. The study findings showed that.

The results reveal that both nurse educators and nursing students generally hold a positive view of gamification in simulation-based education. This high perception among both groups suggests that gamification is seen as an effective tool to enhance engagement and motivation within the learning process. Educators, being the designers of educational experiences, likely recognize the pedagogical value of gamification in fostering a more interactive and engaging learning environment. Their higher perception score could be attributed to their understanding of how gamification can lead to better knowledge retention and skill development in a simulated, risk-free environment. Several studies corroborate these findings [31, 42]. These findings may be attributed to the fact that gamification introduces interactive elements such as digital simulations, which make learning more engaging and practical. Activities like educational escape rooms not only improve teamwork but also receive overwhelmingly positive feedback from students, indicating their perceived value. Among educators and students, gamified approaches enhance critical thinking, decision-making, and clinical judgment skills vital to nursing practice. The results of several studies support these justifications [11, 43].

The studies reviewed indicate that gamification positively impacts nursing education. For example, a quasiexperimental study in Spain found that nursing students had high satisfaction and knowledge scores after a gamification intervention in simulated laboratory practice [31]. These findings suggest that gamification, through interactive elements like simulations and educational escape rooms, enhances key skills such as teamwork, critical thinking, and clinical judgment, benefiting both students and educators.

The study highlights strong support for gamification among both nurse educators and students in simulation labs, particularly in enhancing engagement and motivation. Several factors contribute to these positive perceptions. First, gamification has been shown to boost student engagement and motivation by introducing challenges, incentives, and interactive scenarios, which transform traditional classrooms into dynamic learning environments. This approach fosters active participation and sustained interest. Second, gamification has been linked to improved knowledge retention and learning outcomes in nursing, as it enhances critical thinking, decisionmaking, and the application of theoretical knowledge to practical clinical situations. Finally, the adaptability and ease of implementation of gamification make it a valuable tool in nursing simulation labs, where it can be tailored to specific educational objectives and diverse learning styles.

The findings align directly with previous research. A study in Portugal discussed the role of gamified learning strategies in students' motivation in high school and higher education and reported that engagement and motivation had the highest mean score of gamification dimensions for perception [44]. Similarly, a systematic review and meta-analysis suggested that the most significant effect of game-thinking on academic achievement was observed in the educational knowledge performance of nursing students, followed by academic skill performance [45]. Conversely, a systematic review and appraisal of the evidence reported that games are insufficient to promote nursing students' learning outcomes in different domains, such as engagement and motivation [46].

Our study indicates that nurse educators are confident in the use of gamification within simulation-based education, especially concerning its management and planning on a technical level. The profound confidence in these areas is likely attributable to growing interaction with digital resources as well as rehabilitative training where educators seem to hone their skills in gamification design. Such confidence is fundamental for the effective adoption of gamified instructional practices since educators need this level of confidence in order to offer engaging and successful simulation experiences. Furthermore, the results indicate that continued emphasis on fostering confidence in the design and technical aspects may yield better outcomes for simulation-based learning [47-49].

The research revealed that there is a notable positive correlation between nurse educators' perceptions of gamification and their confidence levels concerning its usage in simulation-based exercises. Higher levels of engagement and achievement among students tend to result in increased confidence in employing gamification, which further enhances perceptions of its usefulness. It is understandable that, with increased experience, educators' perceptions and confidence with gamification enhances motivates them to refine its instructional potential. Such results were also observed in other studies; for example, a study that investigated game-based learning in a digital design course also noted that educators' perceptions of gamification positively correlated with their confidence in using it [50].

The study found that two-thirds of nurse educators were female, consistent with global trends in the nursing

profession being predominantly female. Female educators exhibited slightly higher perception and confidence scores compared to their male counterparts, which could be attributed to traditional caregiving roles associated with nursing. This aligns with previous research, such as Ferriz-Valero et al. (2020), which found similar trends in physical education, where female educators demonstrated higher scores in gamification perception and confidence [51]. Furthermore, the study highlighted that senior educator, particularly those with over 15 years of teaching experience, had the highest perception and confidence scores. This contrasts with the assumption that younger educators, being more tech-savvy, would be more inclined to adopt new technologies. The high scores among senior educators suggest that extensive teaching experience enhances their ability to evaluate and implement both traditional and modern pedagogical methods effectively, a finding that resonates with Ordu & Calişkan (2025), who reported similar results regarding virtual games in nursing education [49].

The thematic analysis revealed that institutional support and policy limitations are areas where educators struggle with the lack of clear guidelines and administrative barriers. Many respondents reported that securing approval and resources for gamification implementation is complex without formal policies or structured institutional backing. Additionally, technological barriers have emerged as a significant concern, with educators citing outdated systems and inadequate IT support as key obstacles to the seamless integration of gamification. The results of other studies are in harmony with our findings. A literature review reported that nursing educators' perceptions of applying resources to gaming instruction revealed that gaming requires more institutional support and policy guidelines [52].

Another promising theme finding highlights faculty and student resistance, with some faculty members preferring traditional teaching methods over gamified approaches. Educators also noted that students sometimes struggle to adapt to game-based learning environments, making the transition to gamification challenging. Furthermore, evaluation challenges were frequently highlighted, as many educators found it difficult to measure the effectiveness of gamification in improving student engagement and learning outcomes due to the absence of standardized assessment tools. This result aligns well with previous studies that have explored barriers to the effective use of computer-based simulation in pharmacy education, revealing that students and educators often resist adapting to game-based simulation [53].

The present study's results showed that training and resource needs were emphasized as a crucial factor affecting the adoption of gamification. Educators reported that a lack of structured training programs and insufficient access to gamification tools hinder their ability to confidently implement gamified learning strategies. Without proper professional development opportunities, many educators feel unprepared to effectively integrate gamification. A similar conclusion was reached by Lomba-Portela et al. in their discussion of "Resistances to Educational Change: Teachers' Perceptions." Education Sciences and illustrated that training and resources need limited access to game-based simulation [54].

The research notes that the integration of nursing education into gamification is blocked by institutional, technological, and pedagogical barriers. To resolve these barriers, it is necessary to have definable institutional policies, improve the technological framework, supply training programs for staff members, and develop standardized assessment policies. Offering structured support and removing barriers fosters educational professionals' self-efficacy regarding the strategic implementation of gamification and consequently learner engagement, which results in better educational outcomes. Similarly, other studies, likewise conducted earlier research, underline the claim that these factors pose difficulties with the use of gamification in the scope of educational activities [53, 55].

#### Conclusion

This mixed-method study provides a 360-degree exploration of the integration of gamification in simulation-based nursing education, offering insights into perceptions, confidence levels, and the multifaceted challenges encountered by nurse educators and students. The findings reveal that both groups generally hold high perceptions of gamification's value, particularly in enhancing engagement, motivation, and learning outcomes. Nurse educators also demonstrated moderate to high levels of confidence in utilizing gamified strategies, particularly among those with advanced qualifications, more experience, and prior training in gamification. Importantly, a significant positive correlation was identified between perception and confidence, underscoring the interdependence of attitudes and self-efficacy in adopting innovative teaching methods.

Despite the positive outlook, several systemic and operational barriers were highlighted, including institutional policy constraints, technological limitations, resistance to change, and the need for targeted faculty training. These challenges underline the critical need for supportive infrastructure, clear institutional guidelines, and ongoing professional development to ensure successful and sustainable implementation of gamified learning strategies. The study contributes to nursing education literature by validating two psychometric tools, the Gamification Perception Assessment Tool and the Nurse Educator Confidence Tool, both of which showed strong reliability and structural validity. These tools offer practical value for future evaluations of gamification adoption and effectiveness.

#### Limitations

The study employed a cross-sectional design, which represents perceptions and confidence at a single moment in time, thereby limiting the ability to infer causality or assess change over time. The study relied on self-report answers, which are vulnerable to social desirability and recall biases. The study was limited to nursing institutes in Cairo, with implications for the generalizability of results to broader national and international settings where educational infrastructures and cultural orientations vary.

#### Implications of practice

This study emphasizes the gaps requiring institutional policies, technological frameworks, and training that facilitate the integration of gamification into nursing education. It states that enhancement of animation features through gamification will depend on the users' level of confidence associated with self-efficacy. The work builds upon existing literature regarding the adoption of gamification systems and offers methodologies for evaluating the consequences of such systems. Further study should examine the impact of gamification over an extended period while also assessing peri-educators' perceptions and perceptions over time.

#### Supplementary Information

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Supplementary Material 1

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#### Data availability

The data are provided within the manuscript or supplementary information files.

#### Declarations

#### Ethics approval and consent to participate

Ethical approval was obtained from the Ethical Committee of the Faculty of Nursing at Helwan University (No. 41 - 19/5/2024). The study adhered to the principles of the Declaration of Helsinki. The questionnaires were shared with the study participants, clearly explaining the study's purpose and the items included in the questionnaire. Written informed consent was obtained from all participants. They were informed about the privacy of their information, assured that the data would be used exclusively for scientific research purposes, and notified that participation was voluntary and the study was harmless. Participants had the right to refuse participation or withdraw from the study at any time. No identifying information was collected to ensure anonymity.

#### **Consent for publication**

Not applicable.

#### **Competing interests**

The authors declare no competing interests.

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