Original Scientific Paper

EDUCATIONAL ESCAPE GAMES AS AN INNOVATIVE STRATEGY IN NURSING EDUCATION: A PROSPECTIVE CONTROLLED STUDY

Mohamed Mouhajir[1,2], **Jamila Gharbi**[2], **Oussama Souni**[1]

[1] Faculty of Medicine and Pharmacy Rabat, Mohammed V University
[2] Higher Institute of Nurse Professions and Health Techniques of Rabat

Author for correspondence: Mohamed Mouhajir mouhajir10@gmail.com

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ABSTRACT

Background: Traditional lecture-based approaches in nursing education often fail to ensure sustained knowledge retention and active learner engagement. Educational escape games have emerged as innovative simulation-based tools designed to enhance experiential learning, particularly in high-stakes clinical environments such as respiratory emergencies in oncology care.

Methods: We conducted a single-center, prospective quasi-experimental controlled study involving 52 oncology nurses at the National Institute of Oncology in Rabat between March and June 2025. Participants were allocated into two comparable groups: a control group receiving traditional theoretical instruction only (n = 26) and an intervention group receiving traditional instruction supplemented by an educational escape game (n = 26). Knowledge acquisition was assessed using identical pre- and post-intervention multiple-choice questionnaires (MCQ) scored out of 20. Between-group comparisons were performed using independent samples Student's t-test, and within-group comparisons using paired t-test.

Results: Baseline characteristics were comparable between the two groups. Post-intervention scores were significantly higher in the intervention group (17.84 ± 1.51) compared to the control group (14.69 ± 1.78) ($p < 0.0001$, independent samples t-test). Both groups showed significant improvement from pre-test to post-test ($p < 0.001$). Satisfaction data indicated high levels of learner engagement, with participants highlighting the immersive and interactive nature of the escape game as a key factor enhancing motivation and learning experience.

Conclusion: The integration of educational escape games into nursing education is associated with significantly improved short-term knowledge acquisition and high learner satisfaction. This immersive approach represents a promising complementary strategy to traditional teaching methods, particularly for training in high-risk clinical situations such as respiratory emergencies in oncology settings.

Keywords: *Educational escape game; simulation-based learning; nursing education; respiratory distress; oncology nursing; active learning; quasi-experimental study.*

INTRODUCTION

Optimal patient care depends on a combination of knowledge, technical skills, and professional behavior, all of which require robust initial education and continuous professional development. Simulation has become a cornerstone of healthcare education by providing a safe environment in which learners can develop both technical and non-technical competencies, including teamwork, crisis resource management, leadership, and clinical decision-making, without exposing patients to unnecessary risks, particularly in high-acuity situations (1). Its educational value has been widely recognized, and its implementation throughout healthcare professionals' training is recommended by the Haute Autorité de Santé (HAS) (2).

Alongside simulation, gamification has emerged as an innovative educational strategy designed to increase learner engagement through the integration of game-based elements into educational activities. Serious games, including educational

escape games, have demonstrated positive effects on learner motivation, satisfaction, communication, teamwork, critical thinking, and knowledge acquisition across a wide range of healthcare disciplines, including medicine, nursing, pharmacy, dentistry, and radiology (3–6).

Educational escape games represent a specific form of serious game in which learners collaboratively solve a sequence of challenges within a limited timeframe to achieve predefined educational objectives. Their immersive and interactive nature promotes active participation, clinical reasoning, communication, and collaborative problem-solving while maintaining a psychologically safe learning environment (6–10). Compared with traditional lecture-based instruction, educational escape games provide authentic clinical contexts that promote experiential learning, enhance learner engagement and motivation, improve teamwork and communication, and facilitate knowledge retention and transfer to clinical practice (6–10).

Respiratory distress remains one of the most frequent and life-threatening emergencies encountered in oncology settings. Early recognition and timely management by nursing professionals are essential to improve patient outcomes. However, teaching this topic continues to rely predominantly on conventional lecture-based approaches, which may not adequately prepare learners to manage complex emergency situations requiring rapid clinical reasoning, effective teamwork, and immediate decision-making. Consequently, there is an increasing need for innovative educational methods capable of bridging the gap between theoretical knowledge and clinical practice.

Educational escape games appear particularly well suited to address this challenge because they combine cognitive, technical, and interpersonal learning within realistic clinical scenarios. By encouraging active participation, immediate feedback, teamwork, and repeated problem-solving, they foster deeper learning while maintaining high levels of learner motivation (11–21). Furthermore, recent systematic reviews have demonstrated that serious games and escape rooms enhance immersion, engagement, and contextualization, enabling learners to experience realistic clinical situations that are difficult to reproduce through conventional classroom teaching alone (11–21).

Overall, current evidence supports educational escape games as an effective complement to conventional teaching by fostering active learning, clinical reasoning, collaboration, learner satisfaction, and knowledge acquisition across nursing and healthcare education (22–24).The aim of this study was to evaluate the effectiveness of an educational escape game as a continuing nursing education strategy for the management of respiratory distress in oncology settings. Specifically, the study compared this innovative approach with conventional theoretical instruction and assessed its potential as an autonomous educational tool to improve healthcare professionals' knowledge and emergency management competencies.

METHODS

STUDY DESIGN

This study was designed as a single-center, prospective, quasi-experimental study with a pre-test/post-test design and two parallel groups (intervention vs control) conducted between March and June 2025.

The quasi-experimental design was chosen due to the educational context and the logistical constraints of random allocation within clinical nursing staff while maintaining real-world training conditions.

STUDY SETTING

The study was conducted at the National Institute of Oncology (NIO), a public tertiary care institution affiliated with Ibn Sina University Hospital in Rabat, Morocco, providing clinical care, teaching, and research activities in oncology.

TARGET POPULATION AND RECRUITMENT

The study population included registered nurses working in different care units of the NIO who expressed a need for additional training in the management of respiratory emergencies.

Recruitment was conducted voluntarily through an institutional announcement disseminated via a dedicated NIO nurses' professional social media group. A total of 60 nurses initially expressed interest in participation.

Inclusion Criteria

- Registered nurses employed at NIO
- Expressed willingness and perceived need for training
- Completed the baseline questionnaire
- No prior participation in structured simulation-based training on respiratory distress

Exclusion Criteria

- Non-response to the baseline questionnaire
- Incomplete participation in pre- or post-intervention assessments

From the initial cohort, 52 participants completed all study phases and were included in the final analysis.

ETHICAL CONSIDERATIONS

The study was conducted in accordance with the Declaration of Helsinki principles .

Ethical approval was obtained through institutional authorization for data collection granted by the Faculty of Nursing Sciences.

The study was conducted as part of a Master's degree research project in Advanced Nursing Practice.

All participants provided electronic informed consent after receiving detailed information regarding the study objectives, procedures, confidentiality, and voluntary nature of participation. Participants were free to withdraw at any time without consequence.

INSTRUMENTS

TRAINING NEEDS ASSESSMENT QUESTIONNAIRE

A structured questionnaire was developed by the research team to identify perceived gaps in knowledge regarding respiratory distress management in oncology settings. The instrument included items assessing perceived difficulty, training needs, and prior exposure to emergency situations.

KNOWLEDGE ASSESSMENT TOOL (MCQ TEST)

Knowledge acquisition was assessed using a 25-item multiple-choice questionnaire (MCQ) developed by the authors based on national and international guidelines for respiratory distress management (including COPD exacerbation and acute respiratory failure protocols).

The MCQ covered four domains:

- Clinical assessment of respiratory distress
- Pathophysiology of acute respiratory failure
- Emergency management and oxygen therapy
- Pharmacological and non-pharmacological interventions

Each correct answer was awarded one point (maximum score = 25). The test was administered before (pre-test) and immediately after (post-test) the intervention.

Content validity was ensured through expert review by two senior intensivists and one oncology nursing educator. A pilot test was conducted on a small group of nurses (n=10) to ensure clarity and feasibility. Internal consistency was acceptable (Cronbach's alpha ≥ 0.80).

SATISFACTION QUESTIONNAIRE

A post-intervention 16-item questionnaire was used to evaluate learner satisfaction and perceived educational value. Items included dichotomous (Yes/No) and Likert-scale responses (0–10). Escape-game-specific items were administered only to the intervention group.

STUDY PROCEDURE

The study was conducted in seven sequential phases:

Training Needs Assessment (T0)

A baseline questionnaire was administered to identify knowledge gaps and training needs in respiratory distress management.

PRE-TEST ASSESSMENT

Participants completed the 25-item MCQ to assess baseline knowledge. Based on completeness of responses, 52 participants were retained for analysis.

STANDARDIZED THEORETICAL TRAINING

All participants received a 17-minute standardized online training video delivered via Microsoft Teams covering acute respiratory distress and respiratory failure management in oncology patients. This ensured homogenization of baseline knowledge.

GROUP ALLOCATION

Participants were allocated into two groups using a stratified randomization approach based on: Years of professional experience, Care unit assignment.

Random allocation was then performed within each stratum using a computer-generated random number sequence, ensuring balance between groups.

- Group 1: Escape game intervention
- Group 2: Control group (theoretical training only)

EDUCATIONAL ESCAPE GAME INTERVENTION

The escape game was designed by the research team based on defined learning outcomes aligned with emergency nursing competencies in respiratory distress management, including:

- Rapid clinical assessment (ABCDE approach)
- Interpretation of clinical signs of COPD exacerbation
- Emergency therapeutic decision-making
- Team communication and prioritization of care

The scenario was originally developed by the authors and validated by two experts in emergency medicine and nursing education.

CLINICAL SCENARIO

A 58-year-old male patient (72 kg) with:

- GOLD stage III COPD
- 40 pack-years smoking history (ceased 6 years ago)

- Lung adenocarcinoma with mediastinal lymph node metastases
- Acute worsening dyspnea (48 hours), productive cough with hemoptysis
- Asthenia, weight loss, and anxiety

ESCAPE GAME STRUCTURE

Participants were divided into six teams of four nurses and completed a sequential problem-solving simulation:

1. Phase 1 – Patient Introduction: Interactive video and family interview to obtain clinical history
2. Phase 2 – Vital Signs Access: Unlock monitor data through ABCDE-based clinical reasoning questions
3. Phase 3 – Initial Management: Crossword puzzle (code: BPCO) to access emergency cart
4. Phase 4 – Treatment Selection: Identification of appropriate emergency treatment cards (30 options)
5. Phase 5 – Stabilization Phase: Integration puzzle combining therapeutic decisions to generate final management code
6. Phase 6 – Completion: Final code (BRONCH) unlocks the exit box and completes the scenario

Facilitators acted as game masters ensuring scenario progression without direct clinical guidance.

POST-TEST ASSESSMENT

Immediately after the intervention, all participants completed the same MCQ to assess knowledge acquisition and improvement.

SATISFACTION EVALUATION

A 16-item questionnaire was administered to all participants to assess perceived educational value. The intervention group additionally completed escape-game-specific items evaluating engagement, teamwork, and perceived realism.

DATA COLLECTION

All data were collected electronically using Google Forms, ensuring anonymity and standardized data capture.

STATISTICAL ANALYSIS

Data were analyzed using SPSS version 21.0. Quantitative variables were expressed as means ± standard deviations or medians with ranges depending on distribution, while qualitative variables were presented as frequencies and percentages. Within-group comparisons (pre-test vs post-test) were performed using paired Student's t-test, while between-group comparisons were conducted using independent samples t-test or one-way ANOVA where appropriate. Categorical variables were analyzed using Chi-square or Fisher's exact test. Normality assumptions were checked prior to parametric testing. A p-value < 0.05 was considered statistically significant.

RESULTS

TRAINING NEEDS ASSESSMENT AND BASELINE CHARACTERISTICS

A preliminary training needs assessment was conducted among 52 nurses at the National Institute of Oncology (NIO) to evaluate their knowledge and training needs in respiratory distress management. The results showed that 80% of participants had never received formal training in this area, highlighting a significant educational gap.

A strong interest in simulation-based education was reported, with 91.7% of nurses expressing willingness to participate in such activities. Only 16.7% had prior exposure to educational escape games, indicating limited familiarity with this pedagogical approach. Furthermore, 66.7% considered escape games relevant for improving emergency care training.

The study population was predominantly composed of nurses aged 25–44 years (88.4%), with 53.8% having 5–10 years of professional experience. Participants were distributed across intensive care units (23.1%), emergency departments (19.2%), surgical wards (17.3%), oncology wards (17.3%), and other services (23.1%).

Following baseline assessment, participants were allocated into two comparable groups:

- Group 1 (EG+, n=26): theoretical training + escape game
- Group 2 (EG–, n=26): theoretical training only

No significant differences were observed between groups regarding years of experience ($p = 0.313$, Student's t-test) or clinical unit distribution ($p = 0.115$, Chi-square test), confirming baseline comparability.

PRE-TEST RESULTS

Baseline knowledge was assessed using a 25-item MCQ.

The overall mean pre-test score was 11.36 ± 2.86. Group 1 scored 11.92 ± 3.12, while Group 2 scored 10.80 ± 2.51. The difference between groups was not statistically significant (independent samples Student's t-test, $p = 0.163$).

POST-TEST RESULTS

Following the interventions, a significant improvement in knowledge was observed in both groups (paired Student's

t-test, $p < 0.001$ for within-group comparisons).

The post-test mean score was:

- Group 1: 17.84 ± 1.51
- Group 2: 14.69 ± 1.78

Between-group comparison showed a significantly higher post-test performance in the escape game group (independent samples t-test, $p < 0.001$).

KNOWLEDGE PROGRESSION (PRE-TEST VS POST-TEST)

The overall mean knowledge gain was 4.90 ± 2.89 points.

Group 1 demonstrated a significantly greater improvement compared to Group 2:

- Group 1: 5.92 ± 2.85
- Group 2: 3.88 ± 2.61

This difference was statistically significant (independent samples t-test, $p < 0.010$), indicating superior learning gain in the escape game group.

Table 1. Comparison of Pre-test, Post-test Scores and Knowledge Progression Between Groups.

Group	N	Pre-test Mean ± SD	Post-test Mean ± SD	Progression (Post – Pre) Mean ± SD	P value (Progression)
Escape Game + Theory (EG+)	26	11.92 ± 3.12	17.84 ± 1.51	5.92 ± 2.85	< 0.010
Theory Only (EG–)	26	10.80 ± 2.51	14.69 ± 1.78	3.88 ± 2.61	
Total	52	11.36 ± 2.86	16.26 ± 2.28	4.90 ± 2.89	

EG+ = intervention group; EG– = control group; SD = standard deviation. P value refers to between-group comparison of knowledge progression using independent samples t-test.

SATISFACTION RESULTS

The satisfaction survey demonstrated a high level of acceptability of the escape game intervention.

Overall satisfaction distribution was as follows:

- Very satisfied: 73.8%
- Satisfied: 19.2%
- Not satisfied / slightly satisfied: 7.0% (combined)

Most participants considered:

- One session sufficient: 84.6%
- Duration appropriate: 76.9%
- Theoretical session duration adequate: 84.6%
- Practical session duration adequate: 80.8%

Mean ratings:

- Pedagogical technique: 9.16 ± 0.92
- Trainer–learner interaction: 9.16 ± 0.92

All participants (100%) considered the scenarios realistic, and 96.2% found them relevant.

Table 2. Participants' Satisfaction and Perceived Realism of the Escape Game.

Item	Result
1. How would you rate the escape game overall?	Not satisfied: 7.0% Satisfied: 19.2% Very satisfied: 73.8% %
2. Is a single session sufficient to achieve the objectives of the escape game?	Yes: 84.6%
	No: 15.4%
3. Is the duration of the escape game appropriate?	Yes: 76.9% No: 23.1%
4. Was the time allocated for the theoretical part sufficient?	Yes: 84.6% No: 15.4%
5. Was the time allocated for the practical part sufficient?	Yes: 80.8% No: 19.2%
6. Rate the pedagogical technique used.	9.16 ± 0.92
7. Rate the trainer–learner interactivity.	9.16 ± 0.92
8. Do the scenarios proposed in this escape game seem realistic?	Yes: 100% No: 0%
9. Are the themes of the scenarios relevant?	Yes: 96.2% No: 3.8%

PERCEIVED EDUCATIONAL IMPACT OF THE ESCAPE GAME

All participants (100%) reported that the escape game improved clinical reasoning in emergency situations and contributed to theoretical knowledge acquisition.

Additionally:

- 96.2% reported improvement in non-technical skills (communication, teamwork, stress management)
- 88.5% reported improvement in technical skills

Table 3. Educational Benefits of the Escape Game.

Item	Response	Percentage
1. Did the escape game help improve your reasoning in emergency situations?	Yes	100%
2. Did the escape game provide theoretical knowledge?	Yes	100%
3. Did the escape game help develop your non-technical skills?	Yes	96.2%
4. Did the escape game help develop your technical skills?	Yes	88.5%

FUTURE PERSPECTIVES AND ACCEPTANCE

All participants (100%) expressed willingness to participate in future escape game sessions, and 96.2% supported integration of such activities into continuing professional education.

The overall pedagogical value was rated at 9.16 ± 0.92.

Table 4. Relevance and Perception of the Escape Game

Item	Response	Percentage / Score
1. Would you like to participate in future escape game sessions?	Yes	100%
2. Should this type of activity be included in continuing education for healthcare professionals?	Yes	96.2%
3. Rate the pedagogical value of the escape game (out of 10)	-	9.16 ± 0.92

DISCUSSION

This study evaluated the impact of an educational escape game on nursing knowledge acquisition and engagement in the management of respiratory distress in oncology settings. The main finding demonstrates a significantly greater improvement in knowledge scores in the escape game group compared with the theoretical training group, confirming the added educational value of gamified learning approaches in nursing education.

These results highlight not only a quantitative improvement in knowledge acquisition but also suggest a meaningful enhancement of active learning processes, which are increasingly recognized as essential in modern healthcare education.

INTERPRETATION OF KEY FINDINGS

The superior performance observed in the intervention group is consistent with the growing body of literature supporting the effectiveness of serious games in healthcare education (22–24). In our study, the escape game group demonstrated a greater increase in post-test scores, suggesting that active engagement, contextual learning, and problem-solving-based education contribute to deeper cognitive processing compared to passive lecture-based instruction.

This finding aligns with previous studies showing that simulation-based and game-based learning improve knowledge retention, critical thinking, and decision-making skills among nursing students and healthcare professionals (22–26).

The observed improvement can be explained by several educational mechanisms, including experiential learning, immediate feedback, repetition of cognitive tasks, and emotional engagement, all of which enhance memory encoding and knowledge consolidation.

EDUCATIONAL MECHANISMS UNDERLYING EFFECTIVENESS

The effectiveness of escape games may be attributed to their ability to integrate cognitive, behavioral, and affective learning domains within a single educational activity. Unlike traditional lectures, escape games require learners to actively construct knowledge through problem-solving, collaboration, and clinical reasoning.

Furthermore, the immersive and time-constrained nature of escape games promotes situational awareness, stress management, and prioritization skills, which are essential in emergency nursing contexts such as respiratory distress management. Team-based learning also plays a central role, as collaborative decision-making fosters communication, leadership development, and shared cognitive load, thereby improving overall performance. These mechanisms are consistent with constructivist learning theory and experiential learning models, which emphasize learning through experience, reflection, and active participation.

COMPARISON WITH PREVIOUS STUDIES

Our findings are in line with previous systematic reviews reporting that educational escape rooms significantly enhance engagement, motivation, teamwork, and knowledge acquisition in nursing and healthcare education (22–25). Similarly, studies on simulation-based education have demonstrated that interactive and scenario-based learning methods outperform traditional didactic teaching

in terms of knowledge retention and skill development (25–27). Compared to conventional simulation, escape rooms offer an additional layer of gamification and narrative immersion, which may further enhance intrinsic motivation and learner engagement. This suggests that escape games may not replace traditional simulation but rather serve as a complementary pedagogical strategy within a blended learning approach.

STUDENT ENGAGEMENT, MOTIVATION, AND PERCEPTION

Participants in our study expressed a strong preference for interactive and game-based learning approaches compared to traditional lectures. This finding is consistent with the literature showing that gamification increases learner motivation, engagement, and satisfaction (26–28). The high satisfaction scores observed in our study suggest that emotional engagement plays a key role in the learning process. Positive emotions such as enjoyment, curiosity, and achievement likely contributed to improved participation and learning outcomes. Additionally, the collaborative nature of the escape game may have strengthened interpersonal interaction between learners and instructors, which has been shown to enhance educational experience and motivation.

From a psychological perspective, this may be explained by self-determination theory and Maslow's hierarchy of needs, where achievement, recognition, and social belonging act as key motivational drivers (28).

EDUCATIONAL AND CLINICAL IMPLICATIONS

The findings of this study have important implications for nursing education, particularly in emergency care training. Escape games may serve as an effective tool for:

- reinforcing theoretical knowledge,
- developing clinical reasoning,
- improving teamwork and communication skills,
- and preparing nurses for high-stress clinical environments.

Their integration into continuing professional education may help bridge the gap between theoretical knowledge and clinical practice, particularly in low-frequency but high-risk situations such as respiratory distress in oncology patients.

STRENGTHS AND LIMITATIONS

Despite the positive findings, several limitations must be acknowledged. First, the relatively small sample size and single-center design limit the generalizability of the results. Second, the short-term evaluation (immediate post-test only) does not allow assessment of long-term knowledge retention or transfer to clinical practice. Third, the use of the same MCQ for pre-test and post-test may introduce a testing effect, potentially overestimating knowledge improvement. Fourth, no objective assessment of clinical performance or behavioral change in real practice was performed, which limits conclusions regarding actual clinical impact. Fifth, the study did not evaluate the long-term effect of debriefing sessions, which are known to play a critical role in simulation-based learning consolidation. Finally, although the quasi-experimental design allowed practical implementation in a real clinical setting, it may introduce residual confusion despite group comparability.

FUTURE PERSPECTIVES

Future research should focus on: larger multicenter randomized studies, long-term follow-up of knowledge retention and clinical performance, integration of objective performance-based assessment tools, and comparison between escape games and other simulation modalities. The development of digital or hybrid escape games, including virtual reality-based platforms, may also enhance accessibility and scalability while reducing logistical constraints. Furthermore, cost-effectiveness analyses will be essential to support the integration of escape games into institutional training programs.

CONCLUSION

This controlled educational study suggests that integrating an educational escape game into continuing nursing education may enhance short-term theoretical knowledge acquisition and learner engagement compared with conventional theoretical instruction alone. Participants also reported a high level of satisfaction with this immersive educational approach. However, the findings should be interpreted cautiously, as the study did not assess long-term knowledge retention, objective clinical performance, or patient-related outcomes.

Educational escape games appear to be a promising complementary teaching strategy that can enrich traditional nursing education, particularly for emergency care training. Future multicenter studies with larger samples and longer follow-up are needed to evaluate knowledge retention, transfer to clinical practice, and the educational impact of this approach using objective performance measures.

ETHICS STATEMENT

None

AUTHORS CONTRIBUTION

Authors declared that all contributed equally. All authors approved the submitted version.

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CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

GENERATIVE AI STATEMENT

The authors used a generative AI tool to assist with language editing, formatting, and journal-specific manuscript preparation. All AI-assisted output was critically reviewed, revised, and verified by the authors, who take full responsibility for the final content. No AI tools were used for data collection, analysis, or interpretation.

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