

Application Research on the Strategy of Serious Game Teaching Method to Improve the Clinical Ability of Nursing Students in Neurosurgery Internship

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Abstract: Neurosurgical patients present complex clinical conditions with high nursing risks. Under traditional teaching models, nursing interns often exhibit challenges such as weak clinical reasoning, insufficient reflective capabilities, and inadequate operational proficiency, which fail to meet clinical nursing demands. This study focuses on neurosurgical nursing interns as research subjects, systematically exploring the application value and implementation pathways of serious game pedagogy in cultivating clinical competencies.

Keywords: Serious game teaching method; Neurosurgery; Clinical competence

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1. Introduction

The strong clinical reasoning and reflective abilities of nursing students constitute a defining characteristic of the nursing profession. They must effectively bridge theoretical knowledge with practical implementation, requiring comprehensive engagement of all sensory modalities. This process demands acute sensitivity to clinical indicators, sharp awareness of nursing challenges, accurate diagnostic judgment, effective intervention strategies, and continuous refinement of professional practices. However, traditional teaching methods in nursing education predominantly focus on textbook theories while lacking authentic clinical simulations. This creates a disconnect between classroom learning and real-world application. In high-risk departments like neurosurgery was characterized by large patient populations, rapid clinical progression, and heavy workloads were combined with rigorous safety protocols and quality control measures during clinical rotations, intern nurses often lack sufficient hands-on training. These constraints limit the development of clinical thinking^[1].

Given the continuous emergence of innovative neurosurgical techniques, surgical procedures, and medical equipment alongside growing public demand for healthcare services, the traditional mentorship model fails to meet the evolving needs of neurosurgical nursing students. The pressing challenges of insufficient critical thinking and inadequate self-directed learning require urgent exploration of new pedagogical approaches to enhance core clinical

competencies in neurosurgical nursing education.

2.1. Clinical competency components and evaluation system

The core clinical competencies for intern nurses in neurosurgery practice encompass three dimensions: clinical reasoning, practical reflection, and professional skills. The clinical reasoning dimension includes patient condition assessment, identification of clinical issues, and development of personalized nursing plans. Practical reflection involves post-event analysis of clinical decision-making processes, evaluation of intervention effectiveness, and improvement planning. The professional skills dimension covers specialized nursing techniques and emergency response capabilities. Current evaluations combine quantitative metrics with qualitative assessments, where quantitative components are assessed through theoretical tests and technical evaluations, while qualitative aspects rely on clinical instructors' daily observations ^[2]. This evaluation approach overemphasizes outcomes, neglecting the process of reflecting changes in interns' clinical reasoning and practical reflection. It fails to objectively assess the entire clinical thinking patterns and decision-making processes of interns in complex medical environments, cannot identify deficiencies in their competencies, and hinders the identification of potential gaps in nursing professionals' abilities.

2.2. Current situation of ability survey and problem focus

To gain precise insights into the clinical competency status of neurosurgical interns, the research team selected a Grade III Class A hospital's neurosurgery department as their research base from June 2023 to June 2024. Using stratified random sampling, they identified 60 interns from the cohort of trainees as study subjects.

This study conducted a systematic evaluation of nursing students' knowledge mastery and practical application skills through three dimensions: clinical reasoning, reflection, and hands-on practice. Using Standardized Patient (SP) techniques, this study established typical neurosurgical crisis scenarios such as acute cerebral herniation and postoperative hemorrhage, with real-time monitoring and analysis of clinical treatment outcomes during simulated scenarios. Structured interviews were employed to collect professional evaluations from clinical instructors regarding interns' behavioral characteristics, clinical thinking patterns, and competency development bottlenecks during the internship (see **Table 1**). Data were analyzed using SPSS22.0 software through double-blind methodology.

Table 1. Survey results of clinical ability status of nursing students in internship

Clinical capacity dimension	Specific evaluation indicators	Data results (percentage/pass rate)
Clinical reasoning ability	The proportion of nursing students who can accurately identify three or more early warning signals of brain hernia	32.6%
	The proportion of nursing students who rely too much on teaching tips and ignore the correlation of disease in complex case analysis	61.6%
Clinical reflection ability	The proportion of students who rarely take the initiative to review after completing the operation	78.1%
	The reflection log only describes the operation process, and the proportion of nursing students who lack reasonable decision-making and in-depth analysis of effect	83.7%
Clinical operational competence	Assessment rate of successful operation of cerebrospinal fluid drainage tube	54.7%
	GCS (Glasgow Coma Scale) operation qualification rate	65.1%
	The proportion of nursing students who are flustered and confused in operation steps when faced with emergencies (such as convulsions of patients)	49.4%

2.3. Traditional teaching dilemma and the potential of serious game teaching method to break the deadlock

Traditional neurosurgical nursing education faces significant challenges. The teaching scenarios remain monotonous, with excessive reliance on ward-based instruction and classroom lectures. Due to patient privacy restrictions and stable clinical conditions, nursing students struggle to encounter critical cases or rare conditions, resulting in weak capabilities in handling special cases. Feedback mechanisms are delayed, as instructors typically provide comments after procedures that are already irreversible if risky. Moreover, evaluations focus solely on procedural correctness while neglecting analysis of decision-making logic, making it difficult to correct cognitive biases. Learning motivation remains superficial, as pure theoretical lectures and mechanical drills make some students feel bored and lack enthusiasm for self-directed learning. Serious games, however, can simulate diverse clinical scenarios, offer real-time feedback, and stimulate interest in learning. They effectively address traditional teaching limitations and provide an effective pathway for cultivating clinical competencies in nursing students.

3. Design and implementation of serious game teaching system for neurosurgery internship nurses

3.1. Game design principles

The serious game teaching system for neurosurgery intern nurses encompasses four key aspects, the clinical authenticity, competency-oriented design, difficulty progression and interactive progression.

3.1.1. Clinical authenticity

A game development committee composed of neurosurgery attending physicians, head nurses, and educational experts must ensure that game scenarios, nursing procedures, and emergency responses align with clinical practice to prevent disconnection from reality.

3.1.2. Competency-oriented design

Game tasks should specifically match clinical competencies, simultaneously developing reasoning skills, decision-making abilities, and reflective thinking.

3.1.3. Difficulty progression

Cases are categorized into three types: single cases, complicated cases, and emergencies.

3.1.4. Interactive collaboration

The system offers two training modes, individual self-practice and team emergency response drills to enhance both independent critical thinking and coordinated operational capabilities.

3.2. Detailed explanation of teaching process planning and implementation points

The teaching schedule follows the neurosurgery internship cycle, adopting a three-phase “progressive and layered” pedagogical approach over four weeks. The first phase is the cognitive development stage, focusing on foundational knowledge acquisition. Each session begins with 15 minutes of “information-packed lecture notes” such as key points of ventricular drainage tube care, followed by virtual training tasks and two 40-minute basic

module exercises. Instructors observe and provide real-time guidance on basic module operations (GCS scoring and routine ward care). After practice, students complete daily learning reports and reflections. Common class issues are addressed through game-based case presentations and hands-on demonstrations with expert commentary. The second phase is skill enhancement, assessed via “case analysis tests” and featuring two 60-minute training sessions to master complex case management and specialized techniques.

Multi-student participation increases difficulty during training, improving practical operational skills. Each week concludes with a 60-minute case review where group discussions identify and summarize issues from virtual training to strengthen clinical decision-making capabilities. The third phase is practical implementation, including a 90-minute high-fidelity critical care scenario simulation. Mentors assign clinical practice tasks based on simulation performance, culminating in dual-track assessment combining “virtual + real” evaluations to formulate personalized professional development plans.

3.3. Integration strategies and synergistic effects with traditional teaching

Serious game-based education cannot replace traditional teaching methods. By integrating classroom theory with gamified learning, abstract pathological mechanisms are vividly demonstrated through interactive games, enhancing nursing students’ practical application of knowledge. After completing ward care rotations, students engage in case-based games guided by instructors to identify clinical scenarios. Through comparing game simulations with real-world clinical practice, they gain insight into the complexity of medical operations. The evaluation system synthesizes game-generated metrics such as reasoning accuracy and reflective depth alongside traditional theoretical exams and practical assessments, breaking away from the conventional emphasis on outcomes over process. Gamified design liberates nursing students from monotonous teaching formats, while clinical practice enhances their sense of achievement through applying knowledge. This “interest-practice-renewed interest” virtuous cycle motivates students to actively participate in education. Such approach not only optimizes teaching resources but also addresses the shortage of rare clinical cases, redirecting resources toward routine case training and optimizing resource allocation.

4. Problems and optimization paths in the application of serious game teaching method

4.1. Low technical adaptability

Serious game development is costly, and the complex neurosurgical clinical scenarios require collaboration among medical experts, game developers, and educational scholars to design systems that accurately simulate pathophysiological changes and medical equipment operations. The high costs make such projects unaffordable for small and medium-sized medical institutions. Additionally, some hospital nursing training centers have outdated computer setups that can’t smoothly run games with 3D environments and real-time interactions. While mobile gaming is portable, its screen size limits the precision of neurosurgical procedures, negatively impacting learning experiences ^[3]. To address this, provincial nursing associations should lead the formation of a “Serious Game Development Alliance” by collaborating with regional tertiary hospitals, universities, and tech companies. This alliance would share development costs and establish standardized neurosurgical care game repositories for free use across member institutions, reducing individual organizations’ financial burdens. Furthermore, integrating 2D and 3D elements, using 2D animations for basic procedures and 3D interactivity for complex operations that

would optimize resource allocation.

4.2. Low practical fit

Some nursing students lack familiarity with the game's operational procedures, requiring an additional 1–2 class hours to learn interface navigation and task activation methods, which occupies time that could be spent on core nursing knowledge. More critically, while some students can complete high-difficulty tasks in the game, they still exhibit “hesitation in operation and disorganized procedures” when facing real clinical scenarios. To address this, a tiered guidance approach combined with scenario-based training was implemented. Before class, students undergo a “pre-game proficiency test” to be divided into “proficient group” and “basic group”. The proficient group advances directly to core challenges, while the basic group receives 15 minutes one-on-one coaching from instructors. Post-game, a “scenario migration training session” was added where instructors simulate emergency situations like “equipment alarms” and “patient agitation” in simulated wards. This allows students to develop response plans using game knowledge while identifying differences between game scenarios and real clinical practice.

4.3. Imperfect management standards

Most hospitals evaluate teaching effectiveness solely through “game completion rates for nursing students” and “theoretical exam scores”, lacking specialized assessment criteria for neurosurgical nursing students' core competencies. This approach fails to accurately measure the clinical thinking enhancement achieved through game-based instruction. Moreover, outdated game content that lags behind clinical guidelines and the absence of dynamic monitoring during teaching processes compromise educational quality stability ^[4]. The study established 20 specific indicators across four dimensions: knowledge mastery, skill development, cognitive growth, and learning experience, with each indicator scored accordingly. A dedicated quality control team rigorously monitors game content quarterly to ensure alignment with updated clinical guidelines, while regularly updating case materials and nursing procedures. Additionally, a dual approach combining random sampling and periodic supervision is implemented to verify backend data and conduct on-site observations, ensuring instructors fully implement the complete process from “game-based learning to debriefing and practical application”.

5. Conclusion

This study focuses on nursing students in neurosurgery internships, addressing key challenges in clinical practice through methodological exploration. By developing a closed-loop system comprising “game design, process execution, collaborative integration, and outcome evaluation”, it creates an innovative research framework tailored to neurosurgical nursing. By leveraging the immersive environment, real-time feedback, and repeatable training features of serious games, this initiative aims to resolve the disconnect between theory and practice as well as limited internship opportunities in clinical settings. The research facilitates nursing students' continuous improvement of clinical thinking, judgment, and operational skills within a safe environment, paving new pathways for reforming nursing education.

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Disclosure statement

The author declares no conflict of interest.

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