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Research on the Construction of a Digital and Intelligent Nursing Simulation Teaching System Based on Best Practice Standards

Guanglin Yang

Deyang People's Hospital, Deyang 618000, Sichuan, China

Abstract: *Objective*: To construct a digital and intelligent nursing simulation teaching case library based on INACSL best practice standards, and to evaluate the effect of clinical teaching for nursing interns under this model. *Method*: The case library was established based on the best practice standards of INACSL. Sixty nursing interns were selected and divided into a control group and an experimental group. The control group received traditional teaching, while the experimental group received digital and intelligent case simulation teaching based on traditional teaching. The theoretical and operational assessment results, clinical practice ability, critical thinking ability, and teaching satisfaction of the two groups were compared. *Results*: The theoretical scores (86.52 ± 4.38) and operational scores (88.15 ± 3.96) of the experimental group were higher than those of the control group (79.63 ± 5.12, 80.24 ± 4.85) ($p < 0.05$). The total scores of clinical practice ability (178.65 ± 12.34) and critical thinking ability (298.42 ± 18.56) in the experimental group were higher than those in the control group (152.37 ± 15.68, 265.19 ± 20.43) ($p < 0.05$). The teaching satisfaction rate of the experimental group (96.7%) was higher than that of the control group (80.0%) ($p < 0.05$). *Conclusion*: The digital and intelligent nursing simulation teaching case library created based on INACSL best practice standards can improve the clinical practice ability, critical thinking ability and teaching satisfaction of nursing interns.

Keywords: Digital intelligence technology; Best practice standards; Simulation teaching; Case library; Nursing practice

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1. Introduction

In the context of high-quality development, nursing vocational education has also shifted from the previous knowledge-imparting model to a competency-based training model. Nursing practice is an important period for students to move from the classroom to the clinical setting, and it mainly cultivates students' ability to apply knowledge to solve real clinical problems and critical thinking. However, there is a disconnection between theory and practice in clinical teaching at present, and students' emergency response ability and clinical thinking are relatively lacking. The traditional "one-to-one" apprenticeship system is restricted by

various factors such as medical safety, ethical privacy, seasonal cases, and tight clinical resources, and thus fails to provide students with sufficient and diverse practical opportunities. Although case simulation teaching can achieve experiential learning through highly realistic scenarios and thereby improve clinical decision-making ability, it also has problems such as scarce case resources, non-standard case writing, disconnection from clinical practice, and lack of unified implementation standards. Therefore, this study intends to create a standardized and digitalized nursing simulation teaching system based on INACSL best practice standards and digital intelligence technology, and evaluate the impact of this system on the clinical practice ability, critical thinking, and teaching satisfaction of nursing interns [1].

2. Data and methods

2.1. General information

By convenient sampling, a survey on satisfaction with clinical practice was conducted among 60 full-time undergraduate nursing interns who were doing clinical practice at a non-directly affiliated tertiary grade A hospital in Deyang City between March 2024 and August 2025. The inclusion criteria were full-time nursing students with the highest degree of undergraduate, who voluntarily participated in the survey and signed informed consent. Exclusion criteria: Those who were absent for more than two weeks due to illness or personal leave during their internship; Those who have received the same kind of mock teaching training. Interns who entered the department from March to August 2024 were the control group (n = 30), and those who entered the department from March to August 2025 were the experimental group (n = 30). There were no statistically significant differences in general information such as gender, age, and academic performance between the two groups ($p > 0.05$), and they were comparable [2].

2.2. Methods

2.2.1. Construction of the teaching case library

Based on the INACSL best practice standards, this study formed a nursing practice simulation teaching team consisting of the deputy director of the nursing department, teaching head nurses, teaching group leaders, and clinical backbone teachers.

(1) Case themes and selection criteria

Based on textbooks such as “Internal Medicine Nursing”, “Surgery Nursing”, “Critical Care Nursing”, etc., the case themes were determined according to the “Intern Training Outline”. Case inclusion criteria: True source, representative, able to reflect the objective laws of the disease, reasonable structure, each case contains more than two nursing knowledge points and skill operation items, can prompt students to think, promote the improvement of clinical practice ability in a targeted manner, complete information, clear description of the disease development process [3].

(2) Case writing template formulation

According to the INACSL best practice standard, a unified case writing template is designed, which includes three major parts: pre-simulation preparation, scenario setting, and guiding feedback. Pre-simulation preparation includes preparations for trainees, teachers, materials, etc., with emphasis on preview tasks; The setting of scenarios should be reasonable and specific, providing guiding hints and teaching objectives; The guiding feedback should be detailed and elaborate on the guiding words and discussion points in the review opening, information collection and analysis, and summary sessions.

(3) Case review and archiving

The case is scored and reviewed by the review panel based on the evaluation index of Nursing Professional case resources, and a meeting is held for experts and authors to discuss and revise it. After approval, it is encoded and archived into the medical simulation system [4].

2.2.2. Teaching implementation

The control group used traditional clinical teaching methods. According to the requirements of the internship syllabus, students were taught one-on-one by a dedicated person in the clinical setting, with the instructor responsible for explaining specialized nursing knowledge, observing and guiding the condition, demonstrating bedside physical examination, and practicing clinical operations.

The experimental group, on the basis of traditional teaching, added the case simulation teaching method in addition to digital intelligence technology. The implementation was divided into three steps in accordance with INACSL best practice standards.

(1) Pre-simulation preparation stage

The instructor sends the case materials and preview questions to the students one week in advance. The students discuss in groups, review the relevant materials, familiarize themselves with the case background and teaching objectives.

(2) Conduct scenario exercises at the Medical Simulation Skills Center

Teachers import pre-prepared cases into the medical simulation system, operate with a computer to make the highly realistic manikins exhibit clinical symptoms and signs that match the cases, and use the virtual clinical environment to create very realistic clinical scenes. Students act as nurses based on the set scenarios and perform tasks such as condition assessment, nursing operations, and emergency treatment for the simulated patients. Teachers monitor students' performance through the system and adjust the difficulty of the situation in a timely manner.

(3) The guided feedback phase is carried out immediately after the practice is completed

The teacher guides the students to conduct a review, allowing them to reflect independently, discuss in groups, analyze their decision-making process, whether the operation is reasonable, whether the teamwork is in place, and the teacher summarizes and comments according to the INACSL standards, thereby strengthening key knowledge points and skills [5].

2.3. Observe the indicators

2.3.1. Theoretical and practical assessment results

At the end of the internship, both groups of students participated in the theoretical examination and clinical skills practical assessment organized by the nursing department. The theoretical examination covered nursing knowledge of common diseases in the internship department, with a full score of 100 points; The operation assessment randomly selects one operation from the case library, and the teachers of the operation group score it according to the scoring criteria, with a total score of 100.

2.3.2. Clinical practice ability

Clinical practice ability was evaluated using the clinical practice ability scale for undergraduate nursing students developed by Yao Pingping et al. The scale consists of seven aspects: clinical nursing, communication and coordination, health education, scientific research and innovation, emergency

cooperation, humanistic care, and clinical teaching, with a total of 44 items. Using the Likert five-point scale, the higher the total score, the stronger the clinical practice ability. The scale has good reliability and validity.

2.3.3. Critical thinking ability

Critical thinking ability was evaluated using the Chinese version of the Critical Thinking Ability Measurement Scale (CTDI-CV) translated by Peng et al. The scale consists of seven aspects: seeking truth, open mind, analytical ability, systematization ability, critical thinking confidence, thirst for knowledge, and cognitive maturity, with a total of 70 items. Using the Likert 6-point scale, the total score ranges from 70 to 420, with higher scores indicating stronger critical thinking ability.

2.3.4. Teaching satisfaction survey

Students using a self-made teaching satisfaction questionnaire after the internship ends. The survey covered teaching methods, teaching content, faculty level, learning outcomes, etc. Fill in anonymously. The options are "satisfied" and "dissatisfied", and calculate the satisfaction rate.

2.4. Statistical processing

Data analysis was performed using SPSS 23.0 statistical software. Measurement data were expressed as mean ± standard deviation ($\overline{x} \pm s$), and the independent sample *t*-test was used for comparison between groups; Count data were expressed as frequency and percentage (%), and chi-square test was used for comparisons between groups. A difference was considered statistically significant when $p < 0.05$.

3. Results

3.1. Comparison of theoretical and operational assessment results between the two groups of students

The results showed that the theoretical and operational assessment scores of students in the experimental group were significantly higher than those in the control group, and the difference was statistically significant ($p < 0.05$). Specific data are shown in **Table 1**.

Table 1. Comparison of theoretical and practical assessment scores between the two groups of students ($\overline{x} \pm s$, points)

Group	Number of cases	Theoretical assessment score	Operational assessment results
Control group	30	79.63 ± 5.12	80.24 ± 4.85
Experimental group	30	86.52 ± 4.38	88.15 ± 3.96
t value		5.634	7.112
p value		< 0.001	< 0.001

3.2. Comparison of clinical practice ability between the two groups of students

The total score of clinical practice ability and the scores of each dimension of students in the experimental group was higher than those in the control group, and the differences were particularly significant in the total score and key dimensions such as clinical nursing, emergency cooperation, and humanistic care ($p < 0.05$). Specific data are shown in **Table 2**.

Table 2. Comparison of clinical practice scores between the two groups of students ($\overline{x} \pm s$, points)

Dimensions	Clinical care	Communication and coordination	Health education	Research and innovation	Emergency coordination	Humanistic care	Clinical teaching	Total score
Control group (n = 30)	38.21 ± 5.62	25.63 ± 3.89	20.15 ± 3.27	12.84 ± 2.56	18.42 ± 4.01	20.93 ± 3.68	16.19 ± 2.95	152.37 ± 15.68
Experimental group (n = 30)	46.85 ± 4.17	28.92 ± 3.51	23.48 ± 2.96	15.37 ± 2.88	25.16 ± 3.74	25.41 ± 3.12	18.46 ± 2.70	178.65 ± 12.34
t value	6.762	3.451	4.122	3.558	6.847	5.067	3.110	7.293
p value	< 0.001	0.001	< 0.001	0.001	< 0.001	< 0.001	0.003	< 0.001

3.3. Comparison of critical thinking ability between the two groups of students

The total score of critical thinking ability of the students in the experimental group was significantly higher than that in the control group ($p < 0.05$), especially showing obvious advantages in analytical ability, systematization ability and cognitive maturity dimensions. Specific data are shown in **Table 3**.

Table 3. Comparison of critical thinking scores between the two groups ($\overline{x} \pm s$, points)

Dimensions	Seeking the truth	Open mind	Analytical ability	Systematic ability	Critical thinking self-confidence	Thirst for knowledge	Cognitive maturity	Total score
Control group (n = 30)	35.62 ± 5.34	38.95 ± 4.76	36.84 ± 5.12	35.17 ± 5.43	34.26 ± 5.05	41.53 ± 4.89	42.82 ± 5.31	265.19 ± 20.43
Experimental group (n = 30)	39.28 ± 4.91	42.17 ± 4.52	44.36 ± 4.38	42.85 ± 4.69	38.92 ± 4.73	44.78 ± 4.51	49.06 ± 4.17	298.42 ± 18.56
t value	2.745	2.683	6.176	5.935	3.662	2.706	5.086	6.574
p value	0.008	0.010	< 0.001	< 0.001	0.001	0.009	< 0.001	< 0.001

3.4. Comparison of teaching satisfaction between the two groups of students

The teaching satisfaction survey showed that the overall satisfaction rate with the teaching method was 96.7% (29/30) in the experimental group and 80.0% (24/30) in the control group. There was a statistically significant difference between the two groups ($\chi^2 = 4.043$, $p = 0.044$).

4. Discussion

This study successfully constructed a digital and intelligent nursing simulation teaching case library based on INACSL best practice standards, and verified through empirical research its significant effect in enhancing the clinical practice ability and critical thinking of nursing interns. The core of the teaching system lies in the deep integration of internationally recognized practice standards with cutting-edge digital intelligence technologies, thereby achieving innovation and optimization of the traditional clinical teaching model.

The case library constructed in this study effectively addresses the pain points of the scarcity and uneven quality of case resources in traditional simulation teaching. Based on the INACSL best practice standards, it not only standardizes the process and content elements of case writing, but more importantly, it structurally integrates key teaching links such as teaching objectives, pre-simulation preparation, scenario design, and guided feedback. This standardized template ensures that each case has a clear teaching orientation and

operability, avoiding fluctuations in teaching quality due to differences in the level of the writers. The results showed that students in the experimental group performed significantly better than those in the control group in both theoretical and operational assessments, which directly demonstrated that teaching based on a standardized case library could more effectively promote students' systematic mastery of knowledge and standardized application of clinical skills. The simulated teaching scenarios based on digital intelligence technology greatly enhanced the sense of reality and immersion in learning. Through the medical simulation system, students can repeatedly deal with various clinical situations in a safe and controllable environment, especially acute and critical cases or rare cases that are difficult to encounter in traditional internships. This high-fidelity experiential learning breaks the limitations of time and space and compensates for the lack of clinical practice opportunities. In the study, the experimental group scored significantly higher in the "emergency coordination" dimension of clinical practice ability, which confirmed this. Students went through the complete process of "error–reflection–improvement" in a virtual context, and their clinical decision-making ability and psychological quality were effectively exercised.

Guided feedback is the core of the simulation teaching and the key to internalizing the ability. In this study, the process strictly adheres to INACSL standards, emphasizing student-centered review and reflection. Through teacher-guided self-analysis and group discussions, students are no longer passively accepting knowledge but actively analyzing the logic behind their actions and decisions. This contrasts sharply with the traditional teaching model of "the teacher does, the student sees". The significant superiority of the students in the experimental group in the total score of critical thinking ability and the scores of each dimension fully demonstrates the irreplaceable role of this structured and deep reflection process in cultivating students' analytical ability, systematization ability and cognitive maturity.

5. Conclusion

In conclusion, the digital and intelligent nursing simulation teaching system constructed based on the INACSL best practice standards provides a scientific, standardized and efficient new paradigm for clinical nursing teaching. It has not only effectively enhanced the clinical practice ability and critical thinking ability of nursing interns, but also received high recognition from students. This teaching model, which combines standards and techniques, has successfully transformed classroom knowledge into practical skills to meet clinical challenges, achieving a deep shift in nursing education from "knowledge imparting" to "ability development".

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Disclosure statement

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