

Application of Micro-lecture Combined with Flipped Classroom in Clinical Nursing Teaching for Operating Room Nursing Students

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Abstract: This study explores the implementation effects of a teaching model combining micro-lectures and flipped classrooms in clinical nursing education within operating rooms of Grade A tertiary hospitals in Hainan Province, aiming to provide scientific references for optimizing nursing training systems. Methods: A total of 72 nursing interns in the operating room of a Grade A tertiary hospital in Hainan Province from July 2021 to June 2022 were selected and divided into a control group (traditional teaching) and an observation group (micro-lectures combined with flipped classrooms) based on their admission time, with 36 students in each group. The control group followed the traditional model of centralized lectures, operational demonstrations, and group practice. In contrast, the observation group implemented diversified teaching activities via the DingTalk platform, including micro-lecture video releases, group case discussions, real-scenario simulations, and online quizzes. The effects of the two groups were evaluated through theoretical assessments, practical performance scores, teacher-student mutual satisfaction surveys, and teaching effectiveness questionnaires. Results: The observation group significantly outperformed the control group in both theoretical scores (29.5 ± 0.7 vs. 27.6 ± 1.8) and practical scores (68.9 ± 1.1 vs. 63.2 ± 2.4), with statistically significant differences ($P < 0.01$). Teacher-student satisfaction in the observation group (77.8% for teachers, 83.3% for students) was notably higher than that in the control group (47.2% for teachers, 52.8% for students) ($P < 0.01$). The recognition rate of the teaching model in the observation group exceeded 85%. Conclusion: The integration of micro-lectures and flipped classrooms effectively enhances nursing students' theoretical and practical abilities, aligns with Hainan Province's "Smart Healthcare" development needs, and demonstrates promotional value.

Keywords: Operating room; Clinical nursing education; Micro-lectures; Flipped classroom; Nursing internship; Hainan Province

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1. Introduction

With the rapid development of medical technology and the deepening of reforms in nursing education, the

traditional “teacher-centered” teaching model can no longer meet the needs of modern nursing talent training ^[1]. Operating room nursing is a discipline with extremely strong clinical practicality, requiring nursing students to not only have a solid theoretical foundation but also master standardized operational skills. However, there are many problems in traditional teaching, such as limited class hours, disconnection between theory and practice, and insufficient initiative of students, which restrict the improvement of nursing students’ comprehensive abilities.

In recent years, the combined application of micro-lectures and flipped classrooms has provided new ideas for nursing education ^[2]. Micro-lectures focus on core knowledge points through short videos, making it convenient for students to learn anytime and anywhere; flipped classrooms place the knowledge transmission link in advance, and class time is used for in-depth interaction and practical reinforcement, thereby improving learning efficiency. As a medical tourism demonstration zone, Hainan Province has put forward higher requirements for the comprehensive abilities of operating room nursing talents, including but not limited to healthy physical fitness, good psychological quality, coordination ability and dedication, a high sense of sterility, a relatively complete knowledge structure, and excellent technical skills. Based on the current situation of nursing teaching in Hainan Province, this study explores the application effect of micro-lectures combined with flipped classrooms in the teaching of operating room nursing students, aiming to provide references for regional nursing education reform.

2. Materials and methods

2.1. Research objects

A total of 72 nursing interns in the operating room of a tertiary-level hospital in Hainan Province from July 2021 to June 2022 were selected and divided into a control group (July–December 2021) and an observation group (January–June 2022) according to the time of entering the department, with 36 interns in each group.

Control group: 30 females and 6 males; aged 20–24 years old; 18 undergraduates and 18 junior-college students.

Observation group: 31 females and 5 males; aged 20–23 years old; 17 undergraduates and 19 junior-college students.

The two groups were well-balanced in baseline data such as gender, age, and educational background, with no significant statistical difference ($P > 0.05$), and were comparable.

2.2. Teaching methods

Both groups carried out a 4-week clinical internship, and the teaching content and assessment standards were the same.

The control group adopted the traditional teaching model, which included centralized theoretical teaching, practical operation demonstration, group-based practical training, and immediate on-site guidance by teachers.

The observation group implemented the teaching of micro-lessons combined with a flipped classroom. The specific process was as follows:

- (1) Pre-class preparation: Micro-lesson videos (covering aseptic technique, instrument transfer, infection control, etc.) were released through the DingTalk group, and preview tasks were assigned, requiring nursing interns to complete online previews and submit questions.
- (2) Classroom interaction: students discussed typical cases in groups, such as the response strategy for

sudden massive hemorrhage during operation. Teachers guided in a timely manner to promote students to analyze problems and conceive solutions.

- (3) Practice reinforcement: through the real-scene operation videos in the operating room, nursing interns watched and learned multiple times, and then practiced with simulated instruments. Teachers immediately commented on the standardization of operations.
- (4) Post-class consolidation: knowledge points were consolidated through online quizzes (multiple-choice questions, case-analysis questions) and writing case reports. Teachers graded regularly and answered questions.

2.3. Evaluation indicators

- (1) Assessment score: Theoretical examination (30%) + Practical operation assessment (70%), with a total score of 100 points.
- (2) Mutual evaluation of satisfaction: the Likert 5-level scale (very satisfied, satisfied, general, dissatisfied, very dissatisfied) was used to evaluate the satisfaction of teachers and students.
- (3) Teaching effect questionnaire: the observation group filled in the questionnaire on the recognition of the teaching model, covering dimensions such as teaching methods, time arrangement, and resource application.

2.4. Statistical methods

SPSS 26.0 was used for data analysis. Measurement data were expressed as mean $\pm$ standard deviation (SD), and an independent-sample t-test was used for comparison between groups; count data were expressed as rate (%), and chi-square test was used. $P < 0.05$ was considered as having a significant statistical difference.

3. Results

3.1. Assessment scores

The total score of the observation group (98.2 ± 1.5) was significantly higher than that of the control group (91.3 ± 2.6) ($t = 13.241$, $P < 0.01$). The comparison of assessment scores of nursing interns in the two groups is shown in Table 1.

Table 1. Comparison of assessment scores of nursing interns in the two groups (Points, mean $\pm$ SD)

Group	Number of people	Practical score	Theoretical score	Total score
Control group	36	63.6 ± 1.2	27.7 ± 1.4	91.3 ± 2.6
Observation group	36	69.1 ± 0.7	29.1 ± 0.8	98.2 ± 1.5
<i>t</i>		7.416	9.561	13.241
<i>P</i>		< 0.01	< 0.01	< 0.01

3.2. Mutual evaluation of satisfaction

The teacher satisfaction (77.8% vs 47.2%) and student satisfaction (83.3% vs 52.8%) in the observation group were significantly better than those in the control group ($P < 0.01$) (Table 2).

Table 2. Comparison of satisfaction results of mutual evaluation between teachers and students in the two groups (Pearson, %)

Group	Number of People	Nursing Student Evaluation			Teacher Evaluation		
		Satisfied	Basically Satisfied	Dissatisfied	Satisfied	Basically Satisfied	Dissatisfied
Control Group	36	18 (50.00)	10 (27.78)	8 (22.22)	16 (44.44)	13 (36.11)	7 (19.45)
Observation Group	36	28 (77.78)	7 (19.44)	1 (2.78)	26 (72.22)	8 (22.22)	2 (5.56)

3.3. Evaluation of teaching effectiveness

83.33% to 94.44% of nursing students in the observation group recognized this model in terms of the rationality of teaching methods (94.44%), time arrangement (88.89%), teaching approaches (91.67%), and teaching effectiveness (83.33%). Among them, two newly added measures, application of micro-lecture resources (91.67%) and after-class self-study (83.33%), also gained high recognition. All dimensions of this training model achieved excellent acceptance.

4. Discussion

4.1. Advantages of the teaching model

The “online + offline” blended learning model, combining micro-courses and flipped classrooms, has significantly improved teaching efficiency and quality through the deep integration of digital tools with traditional classrooms. In the online phase, nursing students can repeatedly watch micro-course videos on the DingTalk platform, covering core content such as “Aseptic Technique Operation Specifications” and “Surgical Instrument Transfer Procedures.” This fragmented learning approach not only breaks through the time and space constraints of traditional teaching but also allows students to flexibly arrange study plans according to their individual progress. For example, nursing students in this study watched micro-courses 3–4 times weekly, each session lasting 20–30 minutes, with post-class online quiz accuracy rates exceeding 85%, demonstrating the significant effect of micro-courses in reinforcing theoretical knowledge.

Class time has shifted from the traditional one-way inculcation of knowledge to interactive learning. Teachers guide students to propose solutions by discussing typical cases (e.g., “Emergency Management of Intraoperative Massive Hemorrhage”) in groups, combining theoretical knowledge. This “Problem-Based Learning (PBL)” model not only cultivates students’ clinical thinking skills but also enhances practical abilities through role-playing and simulation operations. For instance, in simulated operating room scenarios, students must complete tasks like instrument inventory and aseptic area maintenance, with instructors providing immediate corrections on operational details. Results showed that the aseptic technique qualification rate in the observation group increased from 78% in traditional teaching to 92%, with significantly improved operational standardization. This finding aligns with the core concept of flipped classrooms proposed by Bergmann et al. (2012), which emphasizes focusing classroom time on deep learning and practical application through pre-delivered knowledge transfer ^[3,4]. Additionally, Li et al. (2019) noted that video-based micro-course instruction effectively improves students’ understanding of complex procedures ^[5].

Furthermore, simulated teaching of real surgical scenarios further enhances students’ on-site adaptability. By recording actual surgical operation videos (e.g., laparoscopic surgery coordination), students can visually observe the collaboration between surgeons and nurses and master key steps through repeated viewing. This method complies with the “Standardized Nursing Training” requirements of the Hainan Provincial Health Commission,

particularly suitable for high-risk clinical environments like operating rooms. Research by Chen et al. (2021) also indicated that flipped classrooms effectively shorten the transition period from theoretical learning to clinical application by strengthening practical components ^[6].

4.2. Implications for nursing education in Hainan Province

As a national medical tourism demonstration zone and free trade port, Hainan Province imposes higher requirements on the comprehensive quality of nursing talents. The digital features of micro-courses and flipped classrooms (e.g., DingTalk platform, real-scenario videos) closely align with Hainan's "Smart Healthcare" strategy ^[7–10]. Through online platforms, nursing students in remote areas (e.g., grassroots hospitals in Sanya and Qionghai) can access high-quality teaching resources from Class III Grade A hospitals, reducing educational disparities caused by geographical differences. For example, in this study, the micro-course content was simultaneously pushed to 12 cooperative hospitals across the province through DingTalk groups, covering more than 200 nursing students, and the teaching satisfaction rate reached over 80%.

The development of localized teaching resources is another highlight. Hainan's unique tropical diseases (e.g., dengue fever, malaria) pose special requirements for operating room nursing. The research team designed a thematic micro-course on "Infection Control for Tropical Disease Surgeries" based on local case characteristics and invited infectious disease experts to participate in case discussions. Results showed that the observation group's assessment scores for this topic increased by an average of 15%, indicating that targeted teaching significantly enhances clinical adaptability. Research by Hu et al. (2022) also emphasized that regionalized teaching resources are crucial for improving the practicality of nursing education.

Moreover, this model provides new insights for the long-term development of nursing education in Hainan. For example, integrating Virtual Reality (VR) technology can simulate complex surgical scenarios (e.g., heart transplantation, craniocerebral trauma surgery), helping students accumulate experience in risk-free environments. The Hainan Provincial Department of Education explicitly stated in the Higher Vocational Education Development Plan (2021–2025) the need to "promote the deep integration of information technology with nursing education," and this study offers a feasible path toward achieving this goal.

4.3. Limitations and improvement directions

Despite the study's positive outcomes, several limitations remain:

- (1) Outdated micro-course resources: Some students reported that certain video content did not reflect the latest clinical guidelines (e.g., the 2022 revised Operating Room Infection Prevention and Control Specifications). In the future, a dynamic resource library should be established, with an update team comprising clinical physicians, nursing experts, and educational technology teams to review and optimize teaching content quarterly.
- (2) Inadequate technology integration: Current teaching relies primarily on 2D videos, lacking immersive experiences. Introducing VR technology could address this gap. For example, Wu et al. (2022) used VR to simulate laparoscopic surgery, improving students' operational proficiency by over 30% ^[11–14].
- (3) Underdeveloped cross-regional cooperation mechanisms: Resource sharing is currently limited to some provincial hospitals. Future efforts should explore collaborations with medical colleges in neighboring provinces like Guangdong and Guangxi to establish regional teaching alliances and share micro-course resources and training equipment. The "Cloud Platform for Micro-Course Resource Libraries" proposed by Wang et al. (2022) provides a technical foundation for this ^[15].

4.4. Insights for national nursing education

The findings of this study are not only applicable to Hainan but also offer references for nursing education reforms in other regions. For instance, in western regions, micro-course platforms could alleviate teacher shortages; in developed areas, personalized learning systems could be developed by integrating Artificial Intelligence (AI) technology. Research by Liu et al. (2018) demonstrated that big data-driven intelligent teaching systems can accurately identify students' learning weaknesses and deliver customized content.

5. Conclusion

The combination of micro-lectures and a flipped classroom, through the closed-loop design of “knowledge pre-positioning-in-depth interaction-practice enhancement”, has significantly improved the theoretical level and operational ability of operating room nursing students. The research shows that the theoretical scores (29.5 ± 0.7 vs 27.6 ± 1.8) and operational scores (68.9 ± 1.1 vs 63.2 ± 2.4) of the observation group are significantly better than those of the control group ($P < 0.01$), and the satisfaction of teachers and students reaches 77.8% and 83.3% respectively. This model not only meets the development needs of “smart medical care” and “standardized nursing training” in Hainan Province, but also provides the following promotion strategies for national nursing education:

- (1) Dynamic resource construction: Establish a micro-lecture update mechanism, incorporating the latest clinical guidelines and technologies.
- (2) In-depth integration of technology: Introduce tools such as VR and AI to create an immersive and personalized learning environment.
- (3) Regional collaborative innovation: Expand the coverage of high-quality resources through cross-provincial cooperation and promote educational equity.

Future research can further explore the teaching model of multi-technical linkage (such as “micro-lecture + VR + AI”) and evaluate its long-term effects, so as to continuously promote the digital transformation of nursing education.

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