

# Application of the Teaching Mode Combining “Virtual Simulation + Emergency Care Simulator” in Surgical Nursing

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## Abstract

*Surgical Nursing* is a practical and applied course with difficulties in finding, receiving and reproducing clinical cases in the practical teaching process, hindering students from participating in the treatment of patients. In the “Internet plus Education” era, the application of the teaching mode combining “virtual simulation + emergency care simulator”, which deeply integrates modern information technology into education and teaching, is an inevitable trend of medical education and development. It can solve the above-mentioned difficulties, and improve the clinical thinking ability in medical students, comprehensively improve the quality of teaching and cultivating high-quality applied medical talents. This paper discusses the application of the teaching mode combining “virtual simulation + emergency care simulator”.

## Keywords

Virtual Simulation, Emergency Care Simulator, Practical Teaching Reform, Surgical Nursing

## 1. Introduction

In modern medicine, it is required to cultivate “application-oriented” talents with a solid theoretical foundation and strong practical ability who are well-educated and competent for clinical positions. However, in medical practice teaching, it’s often the case that clinical cases are hard to find, receive and reproduce, and students have few opportunities and abilities to participate in the treatment of real patients. Only by traditional teaching modes, medical students are rarely able to practice while learning theoretical knowledge, which restrains the development of their clinical thinking ability. In view of the above, the Ministry of

Education of the People's Republic of China issued relevant documents on deepening education reform and promoting the integrated development of modern information technology and teaching (Ministry of Education of the People's Republic of China (2011-2020) & 2017). Consequently, it is a trend to apply virtual simulation technology and emergency care simulator that integrate new technologies such as the Internet, sensing technology, and artificial intelligence to medical teaching.

## **2. Significance of Practice Teaching Mode Combining “Virtual Simulation + Emergency Care Simulator”**

### **2.1. Connotation**

Relying on virtual reality software and hardware, medical virtual simulation can highly reproduce the course of diseases and simulate operation space, patients, operating instruments, materials, etc., which has strong practicality and helps resolve the difficulties faced by traditional teaching modes in medicine. Supported by computer and artificial intelligence technology, medical emergency care simulator can simulate a variety of physiological and disease characteristics of the human body, conduct systematic coding according to the needs of medical teaching, and give highly sensitive feedback for clinical diagnosis, treatment, nursing and other measures in the teaching process, characterizing it with the advantages of high simulation, reusability, multifunction, and high controllability (Chen & Lu, 2014). The medical teaching mode based on virtual simulation platform and adopting emergency care simulators breaks through the teaching dilemma and improves students' practical ability, thereby training their clinical thinking ability (Wang, Gong, Chen et al., 2021).

### **2.2. Challenges Encountered by Surgical Nursing in Practice Teaching**

*Surgical Nursing* is a practical and applied discipline, and it is a clinical skill required for nurses. In this discipline, undergraduate teaching contains many difficult but important contents, especially the treatment of critically ill patients in Surgical Nursing. However, since such patients are critically injured and need urgent treatment, and students may get infected during on-site teaching, so it is not suitable to carry out practical teaching. As a result, students have no chance to learn and participate in the clinical treatment process. On the other hand, if students are not proficient in professional skills participate in clinical treatment, they may bring secondary injuries to the patients.

#### **2.2.1. Particularity of Experimental Subjects**

The practical teaching of medical and nursing students is the process of cultivating medical talents based on exploring human life science, with patients as the object in practice, so it highlights medical ethics and morality. In addition, invasive and close operation is often conducted for medical care, and the limita-

tions of disease control should be taken into consideration. For school students, it's dangerous to carry out operation and treatment on patients directly. In particular, critically ill patients are not common, and their treatment scenarios have little space for students to participate in and are hard to be reproduced, so students have few chances to practice with real patients as experimental subjects.

### **2.2.2. Dangers in Experimental Environment**

The treatment process of surgical critically ill patients specifically includes pre-hospital first aid, in-hospital treatment, and treatment of corresponding specialties. However, in actual teaching process, these scenes are difficult to reproduce, especially the on-site first aid. In addition, there may be certain dangers in on-site first aid scenes, such as falling objects and collapses. The lack of and dangers in the experimental environment cause a direct impact on the practice teaching of application-oriented talents.

## **3. Application of the Teaching Mode Combining “Virtual Simulation + Emergency Care Simulator” in the Surgical Nursing in Our University**

### **3.1. The Training Platform of Intelligent Virtual Simulated Thoracic Injuries First Aid Thinking of the Department of Surgical Nursing of Our University Came into Being**

The complexity and diversity of clinical diseases and relative lack of typical cases have a great impact on the cultivation of students' clinical skills. The School of Nursing attaches great importance to the practical teaching of surgical nursing. Therefore, in 2019, the Department of Surgical Nursing of our university initiated a training project of virtual simulated thoracic injuries treatment (which has been opened to public on the national virtual simulation experiment teaching course sharing platform—“iLAB-X” platform (<http://www.ilab-x.com>)) (see **Figure 1**), and obtained the approval on the provincial first-class undergraduate course using virtual simulation experimental teaching in the same year (which was recommended to participate in the national review), and won the first prize of the Information-based Teaching Competition among Guangxi Colleges and Universities in 2020.

The training project is based on more than 100 real cases of thoracic injuries received by the affiliated hospitals of our university, and the possible situations of patients are all included. The project incorporates multidisciplinary knowledge and covers 12 common nursing operational skills and first aid skills. The following 4 virtual scene modules experienced by patients with thoracic injuries are reproduced in the project (see **Figure 2**): 1) 120 Emergency center; 2) On-site accident rescue; 3) Emergency treatment in ambulance; 4) In-hospital treatment. The project creates a 24-hour online class for students to cultivate their first aid thinking ability and skills, communication and cooperation abilities (Qin, Yang, Deng et al., 2021).

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## 智能化虚拟仿真胸部损伤的急救思维训练

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试用账号： 试用密码：

胸部损伤是外科护理学教学重点与难点，急诊床旁教学存在病例散发、时间紧迫、动手机会少等问题。本项目以胸部损伤现场急救为切入点，用虚拟仿真技术，完整模拟胸部损伤现场及院内规范救治过程，操作可视化，不受时间、空间、伤者条件等限制，学生可随时随反复训练，增强学生对胸部损伤的临床救治能力和创新能力，实现“完整、有效、安全、可反复、可纠错”的教学目标，延伸了实验内容的深度、广度与实验空间，促进学科不断发展。

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### 实验教学项目负责人情况

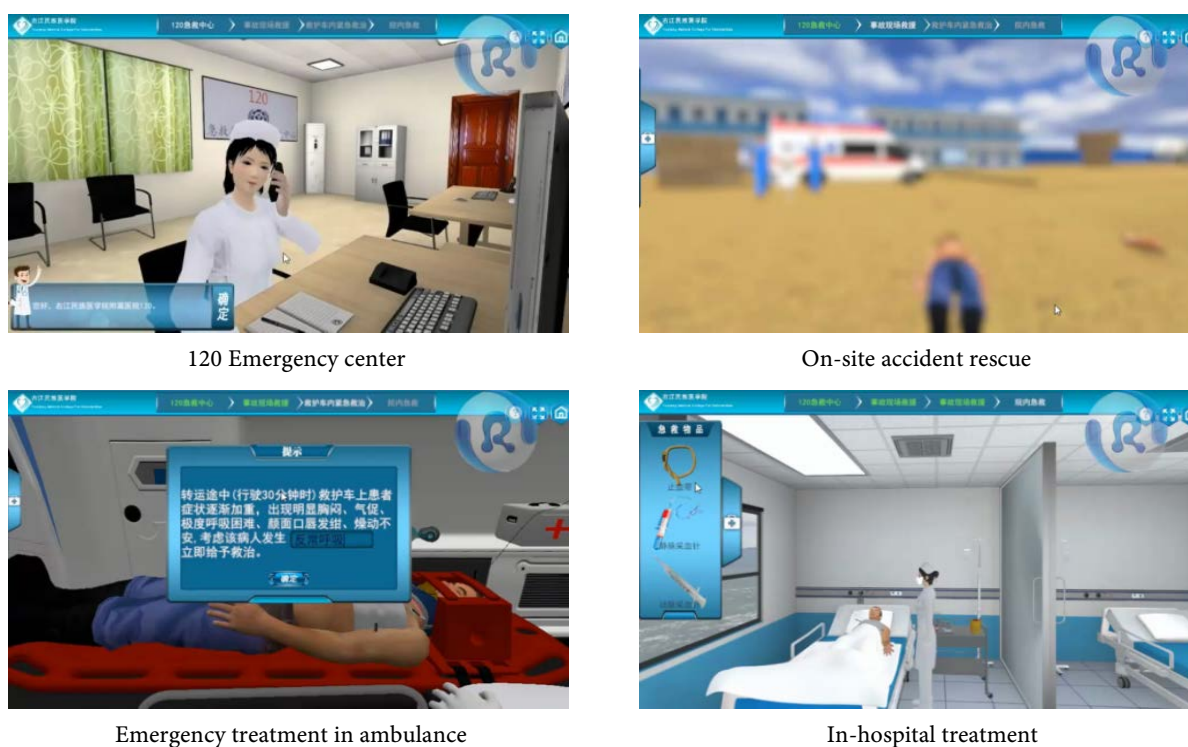
姓名	罗前颖	性别	女	出生年月	1964-08-10
学历	本科	学位	学士	专业技术职务	教授
行政职务	教研室主任	院系	护理学院		

### 教学研究情况

### 共享应用

- 实验浏览量 37307
- 做实验人数 2578
- 实验通过率 93.7%
- 优秀 2249人
- 达标 166人
- 不达标 163人

**Figure 1.** The *Training platform of intelligent virtual simulated thoracic injuries first aid thinking* developed by the Department of Surgical Nursing of our university was opened to public on the iLAB-X.



**Figure 2.** Four virtual scenes in the *Training platform of intelligent virtual simulated thoracic injuries first aid thinking*.

### 3.2. The Introduction of Emergency Care Simulators of the Department of Surgical Nursing

In 2018, the School of Nursing introduced an emergency care simulator (Gau-mard simulator juno-001) (see **Figure 3**), including: one arm with articulation and 1 venous arm; male and female chest skin, wigs and genitals; Real-time electronic box; CEAMaestro command and control software; One arm supporting automated non-invasive blood pressure (NIBP) measurement; teaching tablet computer, etc. These components set the Juno simulator apart from traditional model. With a built-in intelligent system, Juno simulator can simulate a "real" patient by setting parameters through the computer. It can be used by medical students to perform repeated and real-like practices, including: airway care, right subclavian and bilateral chest tube care and maintenance, enema operation, intravenous injection, manual control of carotid pulses, gastric tube indwelling, NIBP monitoring, stoma care and flushing, tracheostomy postoperative care and intubation, catheterization, ventilation, etc. The corresponding parameters can be set with the change of the condition, and the intelligent system can be set and controlled through the computer, so that the simulator will have the same physiological and pathological characteristics as real patients, creating real clinical situations and bringing an immersive practical operation environment for medical students.



**Figure 3.** Juno-001, emergency care simulator in the teaching and research section of the department of surgical nursing.

### 3.3. Application of the Teaching Mode Combining “Virtual Simulation + Emergency Care Simulator” in the Surgical Nursing in Our University

**Instructional design.** *Surgical Nursing* is a compulsory and main course for nursing students. In this course, treatment of thoracic injuries is of great significance to students, with its experimental course accounting for three periods. Since 2019, the Department of Surgical Nursing has applied the experimental course combining “virtual simulation + emergency care simulator” to the training courses. This course is offered in the second semester of the sophomore year of nursing undergraduate students and the first semester of the sophomore year of junior college students. After completing the theoretical learning of thoracic injuries, students will begin their experimental courses in the multi-functional and integrated surgical nursing skills simulation training room with a real working atmosphere, which integrates practical training, advanced intelligent simulation and virtual simulation functions. Experimental courses include: 1) Virtual Experimental Operation of Thoracic Injuries (1 period; online); 2) Actual Nursing Operation on Emergency Care Simulator (ECS) (1.5 periods; in-person); 3) Discussion and Conclusion of Cases (0.5 periods; in-person).

**Examination & Effect.** Examining Method (Figure 4) Score = 40% of online examinations (virtual experiment examinations) + 60% of in-person examinations (case-based teamworking skills OSCE examinations), of which in-person OSCE examinations include the theoretical examination on thoracic injuries cases (40%, Figure 5) and actual nursing operation on emergency care simulator (60%, Figure 6).

The examination takes 40 minutes in total, assessing students’ technical operation, judgment thinking, and patient-centered systematic treatment concept comprehensively. Effect: The pass rate of our students majoring in nursing on the virtual simulation experiment project is 93.7%, while the excellent rate reaches 87.2%; The pass rate of emergency care simulator skill examination is 100%.

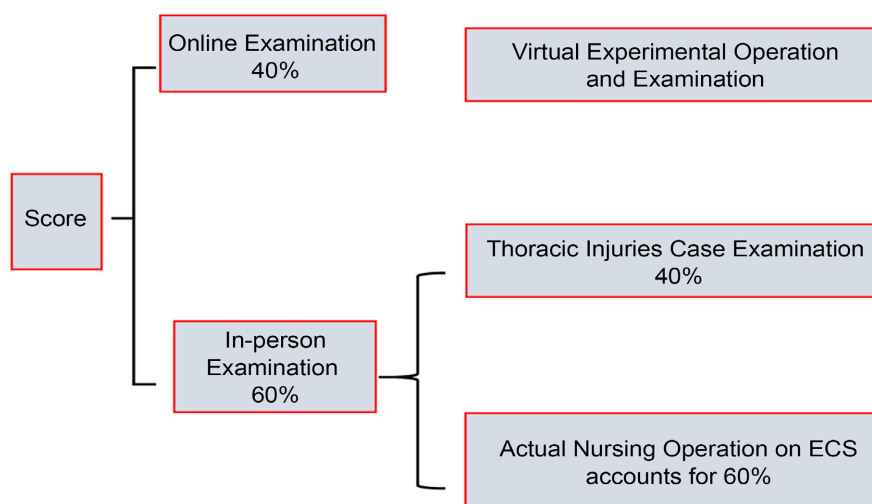
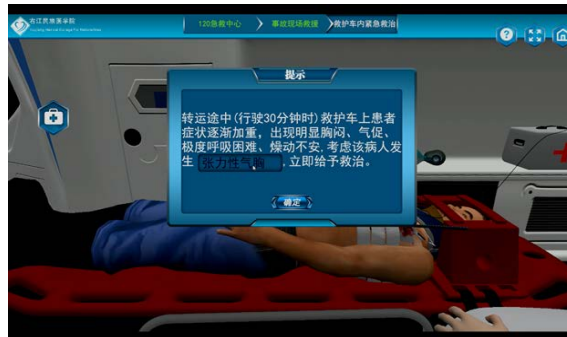


Figure 4. Examination and evaluation.



The screenshot for log roll practices



The screenshot for the examination on thoracic injuries-caused tension pneumothorax

**Figure 5.** Virtual simulation experiment project applied in practices and examinations.



ECS applied in practices



ECS applied in examination

**Figure 6.** Emergency care simulator applied in practices and examinations.

## **4. The Application Significance of the Medical “Virtual Simulation + Emergency Care Simulator” Teaching Pattern**

### **4.1. The Application Significance of the Medical Virtual Simulation**

Medical virtual simulation teaching has a higher requirement for students' autonomy, innovation, constructivity and flexibility (Yang, 2020; Deng, Zou, Su et al., 2022); It also allows trial and error, which greatly improves participants' knowledge and cognitive skills and integrates knowledge into practice better, therefore, participants can learn from mistakes or even can be provided with the opportunity to learn (Pottle, 2019; Kuhn, Huettl, Deutsch et al., 2021; Coyne, Merritt, Parmentier et al., 2019); Its educational purposes include professional health training, education or assessment (Yardley, Teunissen, & Dornan, 2012); Students can carry through the information collecting and clinical decision-making in a safe clinical simulation environment (Norman, 2005); Students are exposed to varied simulation situations, and preview clinical scenarios in advance, so that they can be prepared for the clinic (Edelbring, Dastmalchi, Hult et al., 2011). These exactly make up for the shortcomings of off-line class time and serve as an complement to the traditional medical education (Kononowicz, Woodham, Edelbring et al., 2019).

### **4.2. The Application Significance of Medical Emergency Care Simulators**

With emergency care simulator as a teaching carrier, patients' physiological and pathological characteristics are simulated driven by physiological electricity. The trainees can receive corresponding physiological responses from the simulator shown in the monitoring equipment after performing the rescue and nursing, to create a full-function first-aid simulation environment for nursing students, bring students into a tense rescue atmosphere immediately and arouse students' learning interest (Huang, Liu, Yang et al., 2013); During the whole treatment, students must make full use of every minute, so that they can improve their emergency response ability and first aid awareness; The students' team-work spirit can be invisibly enhanced through group teaching, which can improve the clinical thinking ability of medical students compared to traditional teaching (Yan, Li, Yan et al., 2019; Prosser & Sze, 2014; Sun, Cai, Chang et al., 2021; Ma & Luo, 2020).

### **4.3. The Teaching Pattern of “Virtual Simulation Technology + Emergency Care Simulator” Strengthens the Clinical Thinking Ability of Medical Students: 1 + 1 > 2**

The organic combination of virtual simulation technology and emergency care simulator establishes a real-like, repeatable and error-correcting high simulation experimental environment, which deals with the clinical cases' problems that are difficult to come across, obtain or get involved in. The virtual simulation, a kind



of online teaching, can be described as “virtual”, while the emergency care simulator, related to “reality”, is an in-person teaching. Both of them all link together and can complement each other well, resulting in the effect of making one plus one bigger than two during teaching. The combination of them enhances students’ sense of reality and engagement when practicing, so that students can better understand the responsibilities of medical staff, consider from the perspective of patients indeed, handle the injured and gradually form and strengthen the clinical thinking. As a result, the pattern of “virtual training, theoretical learning-intelligent simulation-practical application-feedback learning” will be formed. The virtual simulation teaching pattern can take the teaching concept of “relying mainly on reality, combining virtuality and reality” as the guiding principle. Meanwhile, the emergency care simulators are applied to solve the tactile sensation problems in the virtual operation, realizing virtuality’s complementing the reality; Students’ thinking ability can be lifted by virtual simulation, while the technique can be practiced in real life. The combination of reality and virtuality can boost students’ clinical thinking ability. For instance, to strengthen students’ mastery of clinical knowledge and skills; To ameliorate the effective way of clinical nurse-patient and doctor-patient communication; To boost students’ resilience to clinical emergencies; To enhance the ability to identify and solve problems; To establish the idea of clinical treatment, clinical judgment thinking ability and humanistic care.

## 5. Conclusion

To sum up, the teaching mode combining “virtual simulation + emergency care simulator” has changed the “teacher-centered” teaching concept and constructed a “student-centered” teaching concept. The difficulty of teaching can be solved through the application of the “intelligent virtual simulation thoracic injuries first aid thinking training” platform online, combined with the application of emergency care simulator teaching, and a safer practice and learning environment can be built. Medical students can carry out medical practice in a controlled environment, better integrate theory with practice, and avoid medical disputes effectively; Having been applied to clinical cases, it can make up for the shortcomings of the high consumption of practical teaching resources and low repeatability, and students can strengthen their scientific clinical thinking in the process of repeated practice-understanding-re-practice-re-understanding. Through the application exploration of intelligent simulation information technology, we have learned our lesson, such as, establishing teachers’ and students’ application standards of information technology capability; At present, the construction of the virtual simulation project in our department needs to be further improved. The treatment phase of this project is only applied in Emergency Department, and the subsequent settings related to treatment scenarios have not been completed yet. We anticipate that the fruits of education and teaching informatization can better serve the training for medical and nursing students during the

continuous improvement and perfection.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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