Perioperative Nursing Gamification Course Design Based on Immersive Virtual Reality Technology Under the Concept of Medical and Educational Collaboration

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Abstract: This paper mainly discusses the perioperative nursing course teaching model suitable for higher vocational education. The core content of "perioperative nursing" course is set according to surgical nursing posts, and gamified course objectives are designed according to learners' cognitive rules. Typical nursing tasks are used as the carrier, teaching case base is formed based on the concept of medical and educational collaboration, and gamified teaching situations are created based on VR technology to optimize the teaching process and enable students to experience the learning process immersive. Enhance students' job competency and professional competence. In the course design, modular teaching, project teaching, team cooperation teaching, gamification teaching, VR immersive teaching, medical teaching collaborative evaluation and other modes are aggregated, and the course design of perioperative nursing is re-carried out.

Keywords: Medical education collaboration; Virtual reality technology; Perioperative nursing; Gamification; Course design

1. Introduction

To address the practical needs of China's healthcare development and to enhance the advancement of medical education, the State Council, the Ministry of Education, the National Health Commission, and other relevant departments have repeatedly issued policy directives emphasizing the importance of "coordination in medical education." These policies explicitly call for the integration of undergraduate medical education, postgraduate training, and continuing professional development. The goal is to improve the overall medical education system by fostering deeper collaboration between medical colleges and healthcare institutions, thereby jointly cultivating medical professionals who are well-prepared to meet job-specific requirements.

Due to the gap between the theoretical knowledge of the classroom and the hands-on clinical practice of students in medical colleges and universities, the medical and health talents that have been cultivated cannot meet the needs of actual employers. As an important link between hospital practice and classroom learning, actively developing clinical case resources has become a key way to train medical talents. Perioperative nursing is an important part of surgical nursing curriculum, which is closely combined with clinical practice. Students need to develop strong clinical thinking skills, and the immersive features of virtual reality can provide them with more diverse and engaging learning experiences. The continuous emergence of immersive technology has injected new vitality into educational innovation. Virtual Reality (VR) technology can not only enable learners to directly experience objects and events that are inaccessible on the physical level, but also enhance learners' participation and motivation, and extend the scope of learning [1]. The core of virtual reality (VR) is the creation of an Immersive Virtual Environment (IVE), which can visualize three-dimensional data, offer an interactive setting, and enhance the sense of presence in a computer-generated world. At the same time, it allows learners to safely simulate real-world tasks in a controlled environment [2].

Immersive learning refers to providing a learning environment close to the real world through virtual reality technology, and learners improve their technical level by participating in interaction and practice. Immersion is a new teaching concept. "Immersion teaching" is the embodiment of immersion theory, with the characteristics of immersion, interaction, and flexible mode [3]. High-quality games offer a stronger sense of immersion for players, and similarly, well-designed gamified learning experiences can provide learners with a deeper and more engaging immersive learning environment [4]. Gamified course design based on immersive learning begins with a focus on course structure, taking into account the learner's sense of immersion. It involves reflecting on current challenges in gamified course design from the perspective of immersion, and rethinking the components and approaches to enhance the overall learning experience.

2. Design of course objectives

To carry out immersive gamification course learning under the concept of medical and teaching collaboration, the learning objective is redesigned. The course design comprehensively considers the goals of cultural foundation, independent development, and social participation, aiming to achieve the "five frameworks"; goal integrity, stage-based progression, hierarchical structure, progressive development, and sustainability. It also adheres to the "seven principles" of immersive instructional design: alignment with learners' cognitive levels; a sense of reasonable substitution; clearly defined boundaries with internal freedom; cross-border experiences simulating real work scenarios; provision of diverse perspectives and references; "pressure valve" mechanisms tailored to learner characteristics; and the replacement of "rule pressure" with "peer pressure" [5,6].

Based on these principles, the perioperative nursing content was categorized into three main sections: preoperative nursing, intraoperative nursing, and postoperative nursing, totaling 16 instructional hours.

2.1. "Perioperative Nursing" course objectives
2.1.1. Social participation objectives
(1) Be able to judge group behavior and individual behavior according to the course design operation instructions.
(2) Ability to regulate the behavior of others and improve personal behavior.

(3) Understand the role of communication in learning through sharing and presentation.

(4) Cooperation, understanding and respect through interaction with other medical staff and patients.

2.1.2. Cultural base objectives

(1) As a ward nurse, it is important to understand the concept of the perioperative period, provide targeted preoperative health education based on the type of surgery, perform standard preoperative preparations, and ensure proper morning care on the day of surgery. (2 periods)

(2) As a ward nurse, it is important to be familiar with the classification and indications of various types of anesthesia, to prepare appropriately for each type prior to administration, and to monitor patients post-anesthesia while providing care for potential complications. (2 periods)

(3) As an operating room nurse, it is essential to correctly navigate from the non-restricted area through the semi-restricted area to the restricted area, and to perform surgical hand-washing, don sterile surgical attire, and wear sterile gloves in accordance with standard protocols. (6 periods)

(4) As an operating room nurse, it is important to be familiar with the layout and management of the operating room, perform appropriate skin disinfection for different types of surgical areas, differentiate the roles and responsibilities of scrub nurses and circulating nurses, and have a thorough understanding of the principles and precautions of aseptic technique in the operating room. (2 periods)

(5) As an operating room nurse, it is essential to assist surgeons by effectively preparing and handling surgical instruments throughout the procedure, ensuring a smooth and sterile operating environment. (2 periods)

(6) As a ward nurse, the ability to assess and manage common postoperative discomforts and complications is essential for ensuring patient safety and promoting recovery. (2 periods)

2.1.3. Independent development goals

(1) Able to reasonably plan class time management.

(2) Develop a sense of teamwork and competition.

(3) Recognize the advantages of teamwork.

(4) Can optimize the shortcomings in perioperative nursing process.

(5) Understand the differences between patients in different care scenarios according to the pre-organizer of the course.

(6) Appreciate the difference between "my care" and "the care of others."

3. Design of teaching implementation process

Currently, surgical education at the institution primarily follows a blended approach combining modular teaching, project-based learning, and clinical internships. To enhance the integration of VR technology into the perioperative nursing curriculum and promote course gamification, the implementation process has been redesigned. This new course model is structured around group-based division of labor, task-oriented learning, task execution, and outcome evaluation.

3.1. Build clinical case nursing teaching process based on VR technology

The "teacher-led, student-centered" task teaching is carried out in the three stages before, during and after

class, and the blended teaching method combining online self-study, statistical feedback, group cooperation and classroom teaching is used. According to the online learning situation, teachers carry out targeted classroom teaching, match teaching objectives to real work situations, construct VR scenes, design typical work tasks, guide students to discuss in class, propose solutions and implement them in VR scenes. The implementation process requires the cooperation of team members to play corresponding roles. Improper operation or no clear division of labor will lead to adverse consequences for patients. When team members perform tasks correctly and work in close coordination with patients, the outcomes can vary significantly. This process is simulated through VR scenarios, allowing students to engage in an immersive and realistic experience of perioperative patient care. The final stage involves presenting the results, engaging in discussion and refinement of the care plans, and reinforcing the learning outcomes. The teaching flow chart for perioperative nursing tasks is illustrated in **Figure 1**.
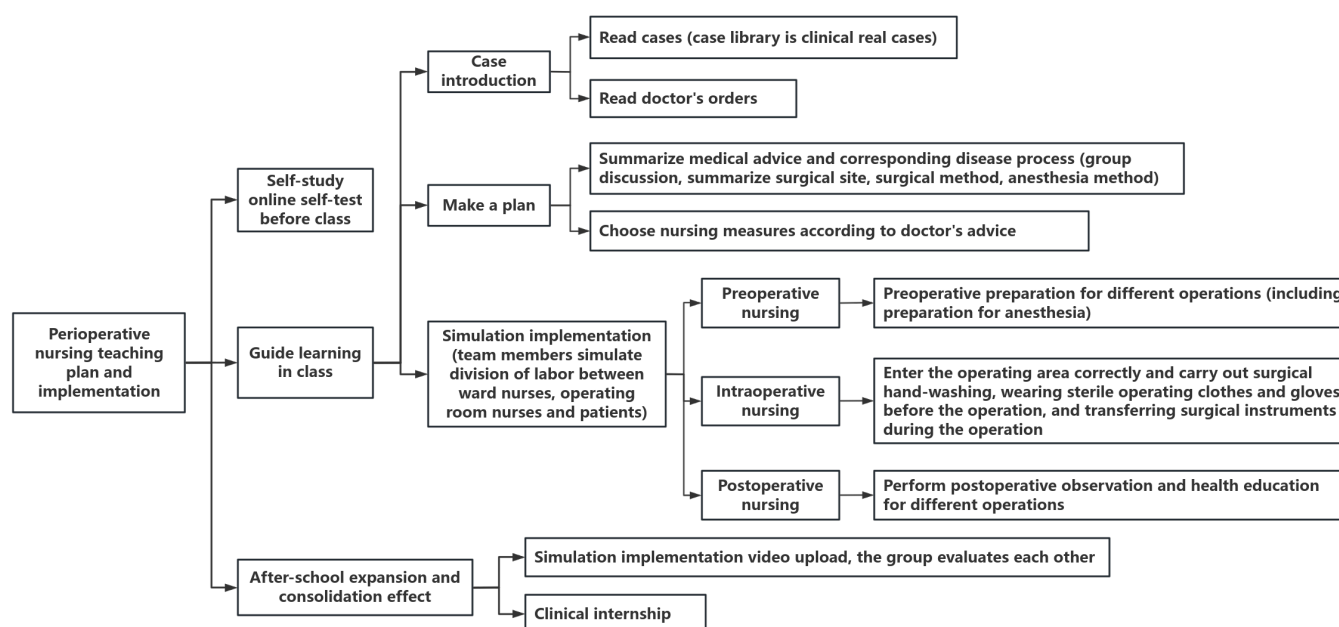

Figure 1. Perioperative nursing teaching plan and implementation

3.2. Construction of gamified clinical case database based on medical and educational collaboration

Case writing in nursing education should be based on real and typical clinical situations. Each case should have a clear and standard format to make it easy to organize and manage. Cases should start simple and gradually become more complex, helping students learn step by step, think critically, and stay interested. All cases must match the teaching goals and syllabus, focusing on key points and common challenges. It is best to choose cases with a single disease and revise them into clear, standard teaching cases [7, 8].

"Surgical nursing" encompasses over 100 common diseases, with perioperative nursing being a key focus. It involves thousands of theoretical knowledge points and corresponding practical skills. The challenge in teaching lies in training students to apply this comprehensive knowledge to solve nursing problems. To address this, the original "surgical nursing" content, covering hundreds of diseases, will be reorganized into five major learning modules: general surgery, brain surgery, chest surgery, exotics, and orthopedics. A total of 15 typical cases of

surgical care were summarized, including 3 gastrointestinal diseases, 1 abdominal injury, 2 biliary tract diseases, 1 esophageal cancer, 1 breast cancer, 2 urinary system cases, 1 nervous system case, 2 fractures, and 1 thyroid disease. For example, the case of appendicitis among gastrointestinal diseases is shown in **Table 1**.

Table 1. Teaching case demonstration

Perioperative nursing of a patient with appendicitis	
[Case No.] 01	[Chapter]19

[Case source] Collection of clinical real cases
[Specialty area, direction] General surgical nursing
[Type of surgery] Emergency surgery

[Case details]
Mr. Zhang, male, 30 years old, was admitted to hospital due to sudden metastatic right lower abdominal pain accompanied by nausea and vomiting for 4 hours. Physical examination after admission was as follows: T: 39.2℃, P: 85 times/min, R: 21 times/min, BP 120/75mmHg; In general, the abdomen is flat and soft, the tenderness of McGregor's point is obvious, and there is no rebound pain. Blood routine: White blood cell count 8.5*109/L, neutrophil 0.87. B ultrasonography indicated appendicitis. Clinical diagnosis: acute appendicitis. Laparoscopic appendectomy under general anesthesia was recommended for emergency treatment.

Task 1: As a ward nurse, please prepare the patients for preoperative nursing.
Task 2: As a traveling nurse in the operating area, please do a good job of intraoperative care for patients.
Task 3: As a surgical instrument nurse, please provide intraoperative care to the patient.
Task 4: The patient successfully returned to the ward, as a ward nurse, please do postoperative care for the patient.

[Scenario hypothesis]
Scenario 1: The patient was not told to fast before surgery, and the patient developed aspiration pneumonia after surgery.
Scenario 2: The traveling nurse did not count the items together with the instrument nurse after the operation, resulting in the stitches being left in the patient's abdominal cavity.
Scenario 3: The instrument nurse did not follow the aseptic principle in the process of washing hands, wearing surgical clothes and gloves, and the patient had an incision infection after surgery.
Scenario 4: The patient did not turn to one side before anesthesia and vomiting asphyxiated; The patient did not change to semi-seated position after anesthesia, and subphrenic abscess appeared after surgery. After 24h, the patient was not informed to get out of bed, and the postoperative intestinal adhesion occurred. The patient was not informed of the feeding time, and the patient ate after being anesthetized and awake, and the appendiceal stump ruptured.

3.3. School-enterprise co-construction teaching evaluation system

Traditional teaching assessment mainly has the following shortcomings [9, 10]:

(1) Focusing solely on professional knowledge and individual skills, the examination format is limited and cannot fully assess the overall abilities of students.

(2) Most assessments are final exams, which do not provide timely feedback on the quality of the teaching process. As a result, teachers are unable to identify issues in teaching and make necessary adjustments to their strategies and methods in a timely manner.

(3) The assessment does not offer sufficient guidance for the development of students' abilities.

The current design adopts diversified assessment forms, process assessment and stage assessment, knowledge, skill assessment and ability assessment, and adopts the model of combining internal evaluation and social evaluation, so as to reflect students' ability and teaching results more comprehensively.

3.3.1. In-school evaluation

(1) Group implementation accounts for 40%. According to the effect of the implementation of the students' situation and the work tasks undertaken in it, the assessment and evaluation are mainly conducted to

examine the students' comprehensive application and teamwork ability.

(2) Theoretical assessment accounts for 40% of the total evaluation and is conducted through a closed-book examination, primarily focusing on assessing students' understanding of basic professional knowledge.

(3) Internship case analysis and report account for 20%. The students' written language expression, oral communication and health education ability are mainly examined by the probation group.

3.3.2. Social evaluation

Social evaluation is introduced at various levels, mainly through the following mechanisms:

(1) In gamification teaching, frontline clinical nursing cadres are invited to participate in teaching, jointly develop gamification cases, implementation plans, evaluation standards, etc., and participate in the situational implementation assessment.

(2) Selected operation pacesetters will participate in an operation skills competition, where their performance will be evaluated by clinical nursing experts.

3.3.3. Student evaluation

The teaching department investigates the students through questionnaires and evaluates them from the aspects of teaching satisfaction, teaching participation, modern teaching methods, and so on.

4. Conclusion

Based on the concept of medical and educational collaboration, this study designed a gamified perioperative nursing course based on VR technology to enable students to carry out immersive learning. It not only contains the essential features of the gamified curriculum goal design, but also pays special attention to the generation of learners' immersion experience. Teaching design should consider not only the construction of a complex and realistic learning environment, but also support the advanced development of students' personalized learning needs. The integration of immersive learning and gamification learning is a concrete attempt to practice personalized wisdom education. This approach aims to accelerate the shift in curriculum objective design under the vision of a learning-oriented society, moving the focus from the course itself to individual students, and from traditional teaching to enriched learning experiences. It serves as an effective strategy for creating challenging and engaging courses in the era of intelligent education, transforming "water lessons" into "gold lessons." Moreover, it represents a meaningful attempt to practice and implement high-quality, student-centered learning that truly prioritizes the learner.

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Disclosure statement

The authors declare no conflict of interest

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