VIRTUAL SIMULATION TEACHING EXPLORATION OF ENDOTRACHEAL INTUBATION LED BY CDIO CONCEPT

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ABSTRACT

New medical science is an inevitable choice to cope with the impact of a new round of scientific and technological revolution and industrial transformation on the medical field. It is also the fundamental way to highlight Chinese characteristics and advantages in the training of medical talents in China, and to explore the localization innovation and connotation leap of medical talents training. Taking tracheal intubation as a practical teaching case, CDIO engineering education concept was used to reform. By constructing a situational virtual scene, the real clinical diagnosis and treatment process was restored, and the actual operation of tracheal intubation was simulated. From the perspective of programming, the Unity3d engine has many outstanding features such as ease of use, security, and flexibility. Its code-driven development mode and high-intensity optimized graphics rendering greatly facilitate the project. In terms of modeling, through 3D human body modeling, users can see through the human body, improve the accuracy of surgery and the risk of surgery is greatly reduced. From the design point of view, the whole interface style is simple and flat, and the color matching is unified. Good results have been achieved, and the students are welcomed by society and enterprises. The CDIO education concept enables students to acquire a wider range of knowledge, with sufficient interpersonal communication ability, professional knowledge application ability, product and system construction ability, so that students can adapt to the industry's demand for talents more quickly after graduation. Through the improvement of talent training ability, the improvement of discipline and professional structure, the optimization of curriculum and teaching material system, the integration of open and collaborative education, and the comprehensive development of teachers and students, the new paradigm of educating people promotes the excellent development of medical education in China around the cultivation of first-class talents.

KEYWORDS

CDIO education model, tracheal intubation, Unity3d, virtual simulation, Standards:1,5,7,8.

THE TEACHING PATH OF TRACHEAL INTUBATION BASED ON CDIO MODEL

CDIO mode is an engineering education mode advocated by international engineering education in recent years (Zhao Rongying, Wang Xu, Qi Yongkang, et al, 2019), which is proposed by four engineering colleges such as Massachusetts Institute of Technology. The model includes four links : Conceive, Design, Implement and Operate. It emphasizes " learning by doing " (Lv Xiangfei, Hu Nanjiang, Yan Lei, et al, 2016) and attaches importance to the cultivation of students' practical operation ability, which is consistent with the training requirements of engineering and applied talents. CDIO mode takes the whole cycle of virtual simulation teaching process of tracheal intubation in anesthesiology as the carrier, and improves students' engineering ability and innovation ability by allowing students to actively participate in immersive learning in various practical links (Yan Qun, Li Qing, Cui Jiarui, et al, 2017).

Limitations of traditional tracheal intubation teaching

Under the background of new medical science, medical teaching is facing new opportunities. Tracheal intubation surgery is the technology of inserting trachea through glottis through special catheter. Due to its high risk and strong practicality, students are generally not allowed to operate on patients. However, students are no longer limited to book education, and tracheal intubation teaching is faced with the situation of uneven supply between medical resources and social needs. In this situation, tracheal intubation medical education is facing transformation. Therefore, the comprehensive reform of the curriculum system centered on the subject, the comprehensive reform of the teaching method based on the CDIO teaching mode and the virtual simulation technology has become inevitable. This will also improve the existing medical education resources. The development of virtual simulation technology can assist clinical medical education and enable students to improve the efficiency of learning while reducing hospital medical costs. Provide students and teachers with a more efficient and convenient interactive learning system. The "tracheal intubation" simulation system integrates teaching, demonstration and simulated surgery, and has the characteristics of realism, immersion and interaction. Users can understand the whole process of surgery more intuitively and learn the operation steps of tracheal intubation more simply. At the same time, it can enable teachers and students to conduct in-depth interactive teaching, so that students can have a deeper understanding of surgery, and can reduce the risk probability caused by misoperation in surgery.

The inevitable way of virtual simulation teaching of tracheal intubation in new medical department under CDIO concept

The teaching reform of the practical course of tracheal intubation is guided by the CDIO concept to guide the practical teaching of medical students. The monotonous repetitive training in the intubation skill training is reasonably transformed into a series of clinical work processes such as the design, evaluation and operation of the tracheal intubation process, so as to improve students' engineering practice ability, the ability to solve practical problems, the ability to explore innovation and the ability to unite and collaborate. At the same time, with the in-depth combination of tracheal intubation teaching theory and virtual reality technology, innovative reforms have been carried out in the teaching content and teaching process, so that the skill training teaching can be effectively improved on the basis of conforming to the learning law and applied education theory, so as to meet the needs of medical students' skill training and development. Using the interactive form of the simulation system, to a certain extent, can avoid the inexperienced students in the clinical operation improper operation ; at the same time, it can reduce the cost of medical education, facilitate teacher-student interaction and improve work efficiency.

The "tracheal intubation" simulation system restores the real clinical diagnosis and treatment process through three-dimensional modeling combined with virtual scene construction. Through code construction, the actual operation of tracheal intubation is simulated and the correctness of the operation results can be fed back in real time. It integrates teaching, demonstration and simulated surgery, and has the characteristics of realism, immersion and interaction. The "tracheal intubation" simulation system integrates teaching, demonstration and simulated surgery. Based on the Unity3d engine, 3ds Max modeling technology and C # programming are used for development. Based on the teaching theory, it is divided into three modules : surgical operation, exercise practice and setting. Through the modular design pattern, it can improve students' learning efficiency more efficiently and test students' ability level more comprehensively. It reduces the cost of medical education and solves the problem of limited operation time and poor understanding of students in clinical education. At the same time, students' scores are recorded in real time, so that teachers can understand students' learning progress and improve the communication efficiency between teachers and students. Secondly, through realistic 3D modeling, real environment construction, movable lens. Enable students to understand the changes in the human body after tracheal insertion from multiple angles. It solves the problem of unclear observation and understanding of the internal structure of the human body in clinical education. Under the background of new medicine, technology has developed rapidly, supporting the information construction of medical teaching, integrating the teaching platform of new technologies such as big data, virtual reality and artificial intelligence, and providing a certain platform for the teaching reform of tracheal intubation. It also helps to construct a multi-level virtual simulation teaching of tracheal intubation with the CDIO concept.The virtual simulation construction platform of tracheal intubation in the new medical department is supported as shown in Figure 1.

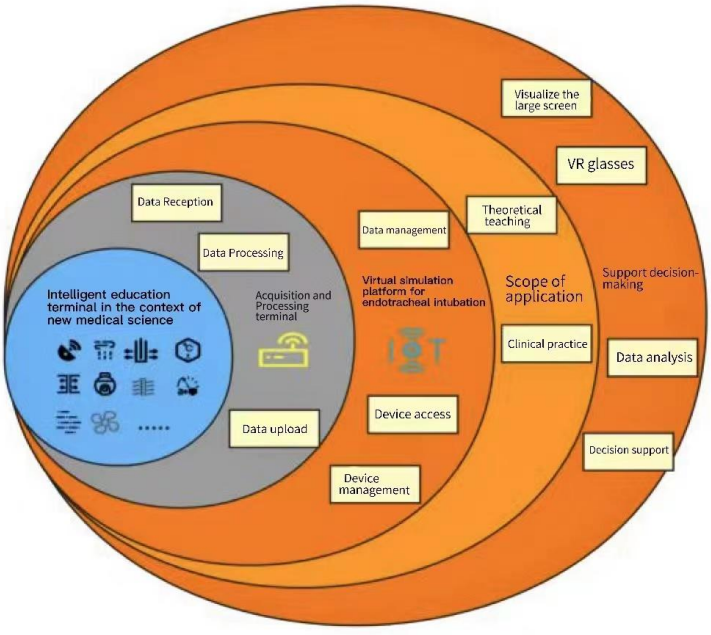

Figure 1. CDIO virtual simulation teaching supported by technology under the background of new medical science

THE CONSTRUCTION OF EXPERIMENTAL PLATFORM OF TRACHEAL INTUBATION VIRTUAL SIMULATION SYSTEM UNDER CDIO CONCEPT

System architecture design based on CDIO mode

According to the sampling survey of some doctors and medical students in a hospital, the results of the demand survey determine that the whole tracheal intubation simulation system of the system realizes the CDIO curriculum system module analysis diagram from the perspective of teaching practice, as shown in Figure 2. It mainly includes five modules, namely UI interface, game logic processing, game sound management, game resource management, and game interaction control. UI interface module is divided into menu page and game page ; the game logic processing module is divided into two modules : scene logic processing and role control processing, in which the scene logic processing is further divided. The game sound management includes two modules : background music control and AI voice control. Game resource management is divided into custom resources and resource manager ; game interaction control includes two modules : interaction design and interaction control.

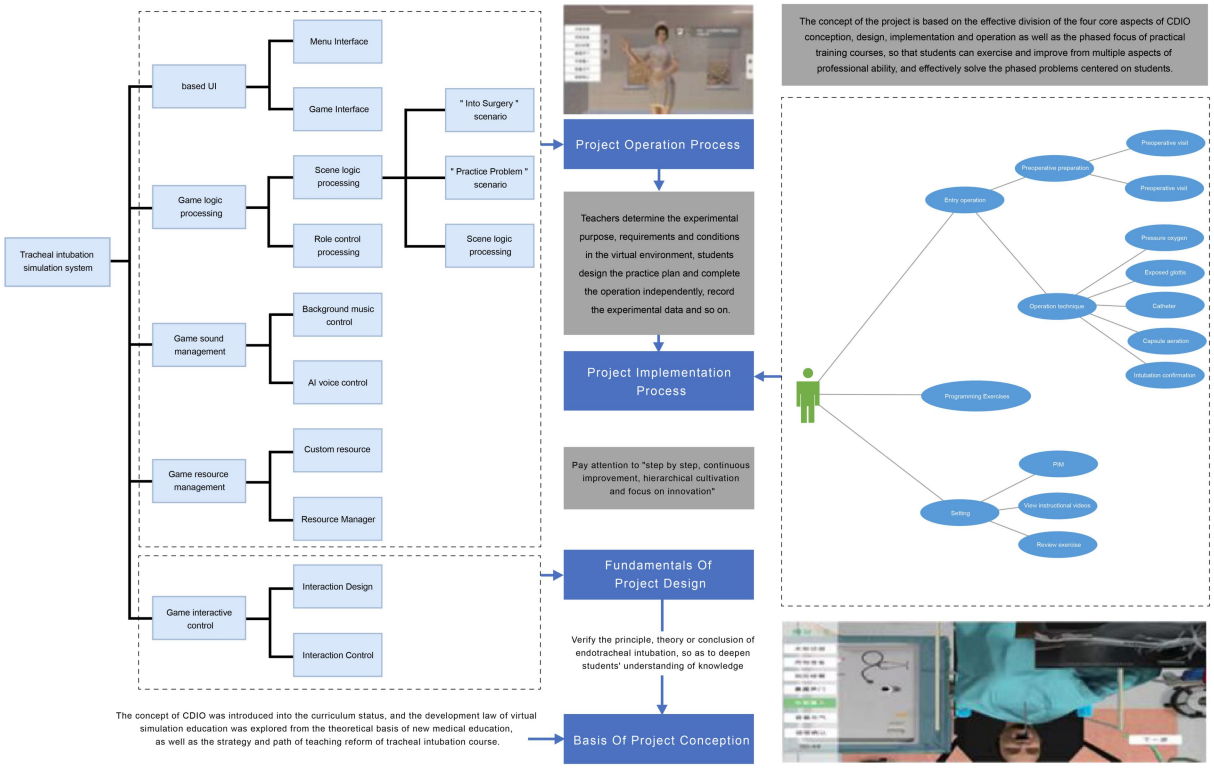

Figure 2. CDIO curriculum system module analysis diagram

The teaching spirit of "teacher-led, student-centered" is deeply reflected. The organic integration of the two can not only give full play to the advantages of CDIO in cultivating engineering practice and innovation ability, but also give full play to the advantages of virtual simulation classroom in improving classroom efficiency, so as to achieve complementary advantages and complement each other. Since the most important social function of the system is teaching, according to the 'block learning' method, several major functions in the system are modularized. Arrange the functional modules in the order of practice-review. Many college courses integrate the two into specific curriculum practice and have achieved

remarkable results. However, most of them still remain in the simple integration of teaching methods, the lack of universal promotion in a single application field, and the individualization of curriculum construction. Ignoring the interrelationship between theoretical courses and curriculum groups or practical courses. Although this kind of surface or local integration can cultivate students' autonomous learning ability, engineering application practice and innovation ability in a relatively short period of time, it cannot effectively cultivate students' knowledge transfer ability, and cannot meet the needs of multidisciplinary interdisciplinary ability, critical thinking, international competitiveness and lifelong learning under the new medical construction. The training goal of compound innovative talents (Chen Jue, 2019) .Therefore, how to realize the effectiveness of the integration of the two and realize the real joint teaching reform of teachers and students needs to fully tap the advantages of virtual simulation training and CDIO concept, effectively design all aspects of virtual simulation training, project content, implementation plan, curriculum quality evaluation system, etc, and realize the comprehensive and systematic integration of courses (Liu Aifang, Du Binbin, Ren Xiaoyu, 2018) .The teaching content of tracheal intubation CDIO understanding into the course content disassembly is described as follows.

Surgical Operation Module

Surgical operation is the core module of the work. Through 3ds Max modeling technology and C # programming technology, various operation functions in the operation are realized. It contains a functional surgical operation function table, as shown in Table 1.

Table 1. Surgical operation function table

Function number	Function name	Functional description
1	Preoperative visit	Check the patient information and briefly explain the surgical procedure
2	Preparation of supplies	Check medical devices and select operating items according to requirements
3	Pressurized oxygen supply	The patients were given pressurized oxygen by balloon mask
4	Expose glottis	Exposing the patient's glottis to facilitate subsequent examination
5	Catheter insertion	Adjust the patient 's posture through the laryngoscope and insert the catheter
6	Inflatable cuff	Receive the ventilator and inflate the airbag
7	Intubation confirmation	The stethoscope confirmed the position of the catheter and fixed the tracheal tube and tooth pad

Practice Module

The exercise module includes three parts : answer system, score system and AI wizard system. The question answering system will list 10 exercises related to tracheal intubation surgery. Students will consolidate their professional knowledge and remember error-prone points by practicing exercises. Improve the accuracy of surgery. The score system will score the answer in the process of answering the question, add the correct answer, and deduct the correct answer. The final score will be integrated into the student's surgical operation score.

And evaluate students' multiple abilities. AI wizard will guide students in the process of answering questions, and present them in the form of pictures and texts.

Setting Module

The setting module includes four parts : personal information management, viewing relevant knowledge points, watching teaching videos, and system setting. Its containing setting function is shown in table 2.

Table 2. Setting the function table

Function number	Function name	Functional description
1	Personal Information Management	Users can view and modify personal information.
2	View related knowledge points	Users can view relevant knowledge points and consolidate basic knowledge.
3	View teaching videos	Users can watch teaching videos and review surgical procedures.
4	System Settings	Users can adjust the system resolution, volume, etc.

Research on teaching methods based on VR technology

"Tracheal intubation" is mainly aimed at novice doctors and medical students to design and integrate the teaching system developed by CDIO teaching concept, providing novice doctors and medical students with sufficient practical opportunities to familiarize themselves with the operation process. Because tracheal intubation is an extremely important link in the process of anesthesia surgery, it cannot be mistaken. Under the background of new medicine, the traditional teaching of tracheal intubation is combined with the emerging technology to allow students to simulate the actual operation. The user opens the "tracheal intubation" system, registers and logs in, and first enters the learning mode selection interface. There are two parts, theoretical teaching and practical simulation. Users can choose theoretical teaching for learning. In theoretical teaching, they can view theoretical knowledge, browse anesthesia instrument information, and enter practical simulation to perform oxygen supply, sign informed consent, select intubation, lift epiglottis and expose glottis.

For the first time, users can use the software to choose the registration module to register new users. Users with successful registration accounts can log in to the account through the login module to start using the software. Users can successfully log in to the selective learning mode module to choose 'theory' and 'practice'. Two different learning modes, the user enters the selective learning chapter module to choose the theoretical knowledge content he wants to learn or enters the viewing anesthesia equipment module, and chooses to view the anesthesia equipment to fully understand the structure and introduction of anesthetics. The user selects the practice simulation operation module to experience the virtual simulation of tracheal intubation surgery. In the text teaching module, the text introduction and nominal interpretation are realized through the Text component in UGUI, and the content switching is realized by using the Button component. InputField component is used to realize the input of text, Image component is used to realize the display of related pictures and the setting of UI background, and Scroll View component is used to realize the

up and down sliding of text content.
In the video teaching module, after entering the three-dimensional virtual scene, the user clicks the projection cloth to play the surgical operation tutorial explained by the professor. This part plays the video through the VideoPlayer, and uses the Button component to realize the suspension and playback of the video. The user can click the button through the handle. Based on the virtual reality module of HTC Vive, in the simulation operation of tracheal intubation surgery, the user uses the HTC head-mounted device as the main interactive medium to perform the operation through the menu key, trigger, side key, touchpad of the handle and according to the system prompt. The implementation of teaching content is shown in Figure 3.

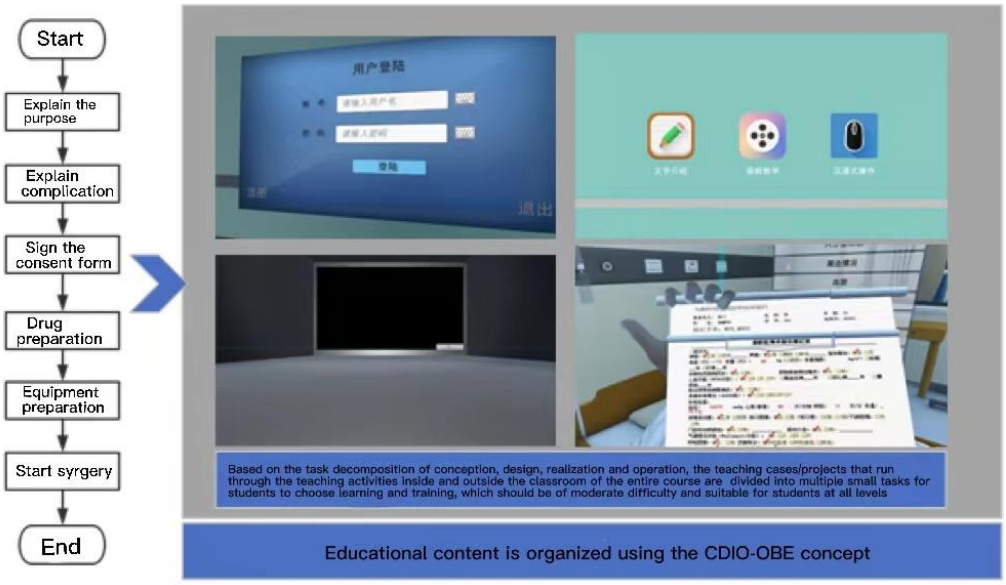

Figure 3. CDIO-OBE understands and organizes the implementation of teaching content

THE TEACHING EFFECT OF STUDENTS IN THE NEW MEDICAL CLASSROOM OF CDIO CONSTRUCTION

Optimization of learning outcomesIn student dimension

The system is analyzed and designed in detail due to the mixed teaching mode of CDIO and virtual simulation, which is driven by project / case. Based on the user group needs of the current medical simulation system, modules such as AI voice wizard system, teaching video playback system, and label system are designed. Using 3ds Max 3D modeling software to create the required medical model in the scene. Such as balloon mask, stethoscope, syringe, etc. The diversification of course assessment methods and assessment objects is closely combined with the purpose of assessment and incentive. Through the study of this systematic virtual simulation course, students can have the basic ability to solve the evaluation and practical operation of tracheal intubation, cultivate students' strong perseverance and critical and innovative thinking ability in scientific research and clinical affairs, and promote the improvement of students' professional quality and national feelings.

And in the virtual human operation, strengthen the students' improvement of humanistic care literacy and the basic medical quality of saving lives and injuries.

Improvement of teaching methods in teacher dimension

Through the integration of CDIO concept into the teaching of virtual simulation course, teachers' ability to observe the differences in students' knowledge understanding and absorption ability is cultivated, which promotes teachers to design teaching links with students as the center, and promotes the improvement of teachers' professional skills and professional quality, so as to realize the continuous improvement of the teaching quality of "tracheal intubation virtual simulation" course. Combined with virtual simulation technology, this paper puts forward the implementation path of the curriculum reform, and constructs the curriculum from the aspects of curriculum structure, curriculum standard, curriculum goal, curriculum content and curriculum evaluation. On the one hand, it broadens the application effect of tracheal intubation training course teaching based on CDIO concept, and then extends to other training courses; on the one hand, let more future medical teachers experience and understand the advantages of the teaching reform after receiving and experiencing the teaching of the training course, so as to drive more secondary vocational teachers to participate in or apply the teaching reform ideas based on CDIO concept, so that it can bring more powerful impetus to the teaching of medical virtual simulation training course (Zhang Shuyuan).

SUMMARY AND APPLICATION PROSPECT

The "tracheal intubation" virtual simulation system is a virtual simulation software with tracheal intubation simulation surgery as the main content. The main purpose is to increase the interest, realism and immersion of traditional medical teaching through the integration of emerging technologies and emerging disciplines. In the software design idea, from the theoretical knowledge, teaching video, to the simulation operation and the final virtual simulation operation, the students are guided by a correct cognitive process. Gradually deepen the students' learning and memory of knowledge. With the help of new equipment, the training opportunities for trainees and novice doctors before actual surgery are increased. At the same time, solid training can also provide strong technical support for novice doctors before surgery and alleviate the tension in the actual operation process. Under the background of new medical construction, it is an important way to realize the national strategic goal to carry out the reform of medical virtual simulation experiment teaching based on CDIO engineering education mode and cultivate applied talents with strong engineering practice ability (Wang Qiyao, Zhang Leilei, Chang Yaning) . The construction of virtual simulation experiment is the direction of experimental teaching reform in the high-tech era. The application of virtual simulation experiment to tracheal intubation teaching is a supplement to the clinical and in vivo experiments of traditional medical education. It is helpful to improve the quality of experimental teaching, strengthen students' understanding of the whole process of tracheal intubation, improve students' engineering practice ability, and cultivate students' ability to solve complex engineering problems.

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BIOGRAPHICAL INFORMATION

Li Xiang is an associate professor at the Dalian Neusoft University of Information ,a CCF member. Currently has a master's degree in design and is a phd candidate in electrical and computer engineering-artificial intelligence. She is the Industry 4.0 Judge of the People's Republic of China Vocational Skills Competition, the internal auditor of the National Military Standard, the official certified lecturer of Unity3d engine, and the deputy director of the Digital Media Technology Department of the Neusoft University of Information School of Digital Art and design. It mainly teaches human-computer interaction technology, interactive device design, game physics, virtual reality development and other courses.

Zhang Mingbao is an associate professor of Dalian Neusoft University of Information. At present, he is a doctor of electronic and computer engineering. The research direction is animation, virtual simulation and digital twin. He is currently serving as the Deputy Dean and Head of Animation Department of Digital Art and Design College of Dalian Neusoft Information Institute. During this period, there were more than 18 projects guiding college students' innovation and entrepreneurship training programs, and 16 projects hosting or participating in provincial and above education and scientific research projects, including one humanities and social science research project of the Ministry of Education and one key natural guidance project of Liaoning Province. Published 5 national high-level papers, 12 E papers, 2 SCI papers, 5 CDIO conference papers, obtained 12 software copyright and utility model patents, and published 11 works.

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