Application of Virtual Simulation Technology Teaching Platform in Clinical Teaching

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ABSTRACT

Clinical teaching is an important link in training qualified medical talents to theoretically connect with reality, and the teaching and training of clinical skills is an integral part. The development of virtual simulation technology, which combines the function autonomous learning platform, morphology digital simulation laboratory, and autonomous learning system forms a virtual teaching space and enhances students' autonomous learning ability. At the same time, it combines virtual and reality to form a new clinical medicine education system, and it has a promising future. The application of virtual simulation technology teaching platforms in clinical teaching can effectively make up for the deficiencies that exist in real-life teaching. At the same time, the solidification of teaching content enables students to more easily accept and understand clinical skills. The explorations in the reform of clinical medicine teaching will benefit the cultivation of higher-quality medical talents and contribute to the medical career in China.

Keywords: virtual simulation; teaching platform; clinical teaching

INTRODUCTION

Doctors are a sacred, special profession, and the ability of physicians is closely related to the skill of diagnosis and treatment. Clinical teaching is a required course for physicians before they enter the career, which includes several skills, such as routine question making, medical record writing, general examination, clinical operation, and surgical operation (Bin et al., 2022), and it is an important turning point for medical students from theory to practice; thus, scientific and perfect clinical teaching is highly important for medical students (Luo et al., 2022). Clinical teaching has placed more emphasis on practicalities than basic medical teaching; hence, in recent years in systems and platforms, research and common sense are more suitable for clinical teaching (Chai et al., 2022).

In recent years, with the continuous progress of science and technology, virtual simulation technology has become more perfect. The clinical skills education platform constructed by virtual simulation technology is also used in the experimental teaching of clinical medicine,

which achieves complex problems in practical teaching visualization and makes students acquire knowledge easily. Virtual simulation technology solves the problems of difficulty in clinical teaching cases, such as difficulty in emergency cases, inability to repeat and watch exercises repeatedly, enhancing the safety of training, and saving costs of experimental training. The advancement of virtual simulation technology can achieve zero consumption and avoid contamination of training and reduce problems of medical waste (Li et al., 2022).

In addition, the efficient conversion of real-life quality medical resources to teaching resources can construct an open quality teaching resource centered on information network technology, which is of great benefit for clinical teaching (Diao & Zhu, 2021). This study reviews several aspects of traditional clinical teaching disadvantages, advantages of virtual simulation teaching, and applications of teaching platforms of virtual simulation technology to explore the feasibility and necessity of the application of teaching platforms of virtual simulation technology in clinical teaching.

DISADVANTAGE OF TRADITIONAL CLINICAL TEACHING MODES

In traditional clinical teaching modes, most of which are the learning of theoretical knowledge in the classroom, there exist problems such as insufficient learning and practice of clinical skills (Ruan et al., 2021). The many disadvantages of the traditional teaching model are mainly reflected in the following aspects.

WITH THE RAPID DEVELOPMENT OF CLINICAL TECHNOLOGY, CLASSROOM TEACHING IS MORE DIFFICULT

In recent years, with the rapid development of medical technology, such as minimally invasive technology, vascular intervention technology, laparoscopic technology, and new surgical instruments, have been innovated and changed to varying degrees (Luctkar-Flude & Tyerman, 2021). The traditional clinical teaching model has been unable to adapt to the modern educational background. The gradual improvement of modern medicine brings expectations and challenges to clinical medicine. The traditional teaching mode cannot complete the teaching experience of high-tech and difficult clinical skills, and the application of virtual simulation technology can perfectly solve this problem.

STUDENTS HAVE DIFFICULTIES IN PRACTICAL LEARNING, AND THE OPPORTUNITIES FOR INTERNSHIP OPERATION ARE REDUCED.

In recent years, with the improvement of China's law on licensed doctors and the renewal of the regulations on the handling of medical accidents (Sud et al., 2021), students who have not obtained the doctor's qualification certificate are not allowed to perform diagnosis and treatment operations. In addition, with the increasing self-protection awareness of patients, there exist fewer conditions for students to conduct clinical practice directly on patients (Yuan et al., 2020). Clinical medicine has considerably high requirements for students' practical ability. Virtual simulation can provide students with practical opportunities and meet the needs of clinical teaching.

SPECIFIC DISEASES CANNOT BE EXPLAINED THROUGH TRADITIONAL TEACHING

In clinical medicine, many diseases are special, seasonal, and regional, whereas typical teaching cases can be encountered but not sought. Therefore, traditional education cannot explain specific diseases in practice. In addition, many actual scenarios of specific diseases (such as poisoning and allergy) cannot be simulated (Sweeney et al., 2021), which also makes it impossible to analyze and explain specific diseases in the traditional clinical teaching. The

teaching of virtual simulation technology can perfectly realize the simulation scene mode and meet different teaching scenes.

HIGH-COST PRACTICAL OPERATION TOPICS CANNOT BE REPEATED

In traditional clinical medicine courses, with high-cost experiments or surgical operations, many students can only have one observation and learning opportunity and cannot perform multiple repetitions and simulations of the experiment. The teaching of virtual simulation technology can provide students with multiple and repeated learning opportunities, such that students can complete high-cost experiments or surgical operations that cannot be provided by traditional clinical teaching through their own practice (Chou, 2021). Virtual simulation technology can also complete high-cost trials or surgical procedures, which cannot be provided by traditional clinical teaching (Kane & Sowa, 2021).

THE TRADITIONAL CLINICAL MEDICINE MODEL CANNOT ADAPT TO THE CULTIVATION OF HIGH-END MEDICAL TALENTS AT THIS STAGE

China has never stopped the pace of medical reform. Only through continuous innovation and creation can the learning mode be promoted and improved. Future medical education will conduct clinical teaching courses for students on the premise of coordinating medical education and meeting the needs of health services (Hou et al., 2021). The essence of clinical medical education is to face the future and cultivate high-end medical talents needed by the country and society in the future (Singh et al, 2021). In such a social context, only through the new type of clinical medical education can a large number of high-end medical talents who meet the needs of society and have international competitiveness be cultivated.

CONCEPTS OF VIRTUAL SIMULATION TECHNOLOGY

Virtual simulation technology has been more widely used in recent years, and it has achieved some effects in different fields. It is basically the creation and experience of a virtual world by computer systems; in addition, it is used as a foundation, assisted by related technological means, to simulate the known or unknown world, such that people can obtain a real feeling of computer application technology, with characteristics such as interactivity, authenticity, and polypeptibility (Li et al., 2021). Virtual simulation technology enables the integration of computer graphics and images for processing and scenario reproduction and represents an essential leap in comparison with traditional image reproduction techniques (Duan, 2020). The image processing ability of virtual simulation technology is not limited to the reproduction of the object itself, but the simulation of the whole scene, such that it can be displayed in front of the three dimensions.

In recent years, virtual simulation technology has continuously developed and advanced, and many fields have its applications, such as learning, entertainment, remote control operation, and simulation teaching (Zhao, 2020). Virtual simulation technology is gaining increasing attention, given that its application in the medical field is still at its infancy; especially in teaching, more in-depth research and improvement are needed. The teaching platform of virtual simulation technology is bound to have a wide application prospect in the field of clinical teaching.

APPLICATION STATUS OF VIRTUAL SIMULATION TECHNOLOGY TEACHING PLATFORM

In recent years, with the increasing maturity of virtual simulation technology, the teaching field of this technology has gradually formed a scale and system. Medical colleges and universities in Europe, America, and other countries have begun to vigorously perform investment and research and development of virtual simulation technology; and many well-known medical colleges and universities in China are also building clinical teaching skill training centers, with virtual simulation technology teaching mode as the main body (Dong, Y, 2021).

Some medical colleges in China have gradually applied virtual simulation technology to teaching and experiment in specific scenes in the teaching process of different majors to improve the teaching standards that traditional clinical medicine cannot meet. The application of virtual simulation technology fundamentally improves traditional teaching, which has shortcomings and disadvantages, greatly improves the teaching quality, and has also been recognized and praised by the majority of teachers and students. Combining pseudo simulation technology with practical skill training in clinical teaching is not only a breakthrough in clinical teaching but also a revolutionary practice of future teaching concepts (Conigliaro et al., 2020).

There still exist a large gap and difference between virtual simulation technology and virtual simulation technology teaching platforms. In the past, the most basic simulation experiment applied in clinical medical practice classrooms has not reached the teaching standard of virtual simulation technology teaching platforms (Wu et al., 2019). With the continuous development of medical teaching, according to the basic idea of information construction of higher education and setting up virtual simulation experiments, using digital technology and virtual simulation technology to jointly establish virtual experiment teaching platforms has become the trend of current medical education. China's medical teaching has been vigorously promoting the clinical practice ability and innovation ability of students as the core of medical education.

A virtual simulation clinical teaching platform with perfect functions, comprehensive teaching, and strong comprehensiveness has been built for students by relying on a large number of national clinical skill experiment comprehensive education centers in China. Through this platform, the education quality of medical talents in medical colleges can be comprehensively improved, meeting the fundamental goal of training high-end medical talents. The application of virtual simulation technology teaching platforms in clinical teaching has become an important part of clinical teaching.

COMPOSITION OF VIRTUAL SIMULATION TECHNOLOGY TEACHING PLATFORM

INTELLIGENT SIMULATION AND EQUIPMENT LABORATORY

With the vigorous development and promotion of virtual simulation technology teaching platforms in medical colleges and universities in China, many medical education experimental centers in China have the instruments, equipment, and software development conditions required by the virtual simulation technology teaching platform, which fully meet the needs of multi-disciplinary clinical practice teaching. Cui and Zhang (2019) used a SimMan advanced intelligent simulator in their study.

Driven by advanced computer technology, the simulator can simulate the real pathological, physiological reactions and clinical characteristics of the human body, as well as the symptoms and treatment scenes often encountered in clinical practice; and it has a considerably high simulation effect. The simulator with a heartbeat can also blink, speak, breathe, and know human signs. It has the respiratory system, nervous system, and urinary system. Furthermore, it can make the physiological and pathological reactions required by the experiment to simulate various reactions and signs of a real human body in the process of practice and create a near-real clinical simulation scene. Intelligent simulators and simulation equipment have been applied in the teaching of various specialties of clinical medicine in many medical colleges.

Blackburn (2014) applied intelligent simulators and simulation equipment to the clinical teaching of gastroenterology. Intelligent simulators have a complete human digestive system and can enable students to perform different teaching links, such as disease diagnosis, emergency rescue, and surgical operation. Intelligent simulated humans can assist clinical teaching to complete the teaching contents of basic diagnosis and treatment operations and disposals, such as routine diagnosis, disease examination, emergency first aid, and acupuncture and puncture.

VIRTUAL SIMULATION SURGERY AND ENDOSCOPY TEACHING PLATFORM

In clinical teaching, the teaching of surgery and endoscopy has always been the key and difficult point in medical experiments. The teaching content is highly complex. The traditional clinical teaching and training cycle is long. Students basically cannot practice and learn on real patients; thus, they cannot really master the skills of surgery and the operation process of endoscopy (Yang, 2018). Virtual simulation surgery and endoscopy teaching platform perfectly solve the shortcomings of traditional clinical teaching. For example, the Da Vinci robot can simulate a surgery system, virtual surgery operation system, laparoscopic surgery training system, and electronic endoscope teaching system, which can effectively improve the quality and efficiency of teaching (Ying et al., 2018).

The Da Vinci robot simulation system is a simulation equipment specially designed for surgical training. It can provide students with three-dimensional virtual scenes and write the standard surgical procedure flow into the robot arm training system. The system includes the use of surgical needles, electrocautery, tissue cutting, and other modules, such that students can master the surgical process and operation skills in the process of simulating the actual operation (Zou, 2018).

The virtual surgery platform simulates the real surgical scene for students, including a virtual operating table, operating lamp, surgical instruments, and manikin, such that students can practice the simulated surgery and cultivate the response ability to emergencies. Virtual laparoscopic surgery training is a virtual reality training system that can simulate the whole process of laparoscopic surgery, including basic operations such as cutting, electrocoagulation, object transfer, and two-handed assistance (Wang, 2017). It has a highly important training effect and value for students to master the basic operation of laparoscopy.

The simulation electronic endoscope teaching system simulates the whole process of gastrointestinal endoscopy and surgery through a computer three-dimensional visual system. The system adopts human anatomy visual reproduction technology and forces feedback technology to provide students with a real endoscope simulation environment. Students can conduct comprehensive learning and training in the simulation environment to improve students' direction, cognition ability, and hand–eye coordination ability. In this simulation system, students can practice gastroscopy, enteroscopy, and other instruments repeatedly and perform routine operations, such as gastrointestinal examination and endoscopic retrograde angiography (Halstead et al., 2011). In addition, the teaching system can perform real-time evaluation and suggestions according to the students' operation results and training process, thereby continuously improving students' practical operation ability.

VIRTUAL ONLINE LEARNING AND TESTING PLATFORM

The online learning platform is based on the network database and integrates the video open class, online medical record resource database, and medical teaching system to form a virtual online teaching platform. The open classes of famous teachers are made into videos and are uploaded to the virtual online learning platform, such that students can learn and listen to the explanation and training of famous teachers anytime and anywhere. In this manner, resource

sharing among medical students all over the country is realized when they cannot study in class in person. In the current clinical teaching environment, students can only contact patients through practice.

Moreover, students often cannot contact some typical cases and cannot understand all the typical clinical manifestations and treatment processes in the actual working environment due to limited patient resources. By relying on the virtual online learning system, the diagnosis and treatment cases across the country can be summarized; an online case resource database can be established; multiform medical information, such as text, image, and video can be integrated; and a case-based and clinical path-oriented resource database can be established. Students can realize online self-study anytime and anywhere (Gao et al, 2021). Through the virtual online learning platform, more students can enjoy the perfect and comprehensive information resources in the medical record database. In addition, the platform includes an image case database and new image technology, thereby creating a new digital image teaching mode.

The virtual online testing platform is used as the assessment, evaluation, and testing platform of learning content, including theoretical knowledge assessment, clinical skill assessment, and other aspects (Medley & Horne, 2005). Students can test the results of different learning projects through the virtual online test platform. The test content covers multiple stages in clinical medicine, which plays a considerably important role in students' transformation from theory to practice (Huang, 2020).

CONCLUSION

As a new teaching mode, the virtual simulation technology teaching platform has the advantages of safety, efficiency, real learning experience, and adjustable teaching process. It has played an increasingly important role in cultivating medical talents. This model will integrate into every link of clinical teaching, make the teaching content more visualized and three-dimensional, make up for the shortcomings of traditional clinical teaching, and realize the concept of comprehensive information-based teaching reform. However, the shortcomings of virtual simulation technology should still be recognized.

Given the particularity of medical specialty, simulation technology cannot be fully integrated with clinical medicine. For example, the skin tissue of the simulated human body is equal to that of real patients, which has great differences. During the virtual simulation, students cannot really feel the differences in strength, angle, and real feeling in the process of thoracic puncture. At the same time, simulated people cannot make real feedback in the experiment, making the lack of communication and communication between doctors and patients in the simulation process. In addition, there exist more interference factors in the real work scene, such as the surrounding environment and character factors, which will not be encountered in the virtual operation.

Therefore, virtual simulation teaching can only be used as an auxiliary teaching mode in clinical teaching to make up for the shortcomings of traditional teaching, but it still needs to be combined with traditional teaching for practice and integration. With the development of medical technology, network technology, and multimedia, the teaching platform of virtual simulation technology will become increasingly mature and perfect and will promote discipline research and improve teaching quality to better contribute to medical education.

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