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LETTER TO THE EDITOR

Virtual reality: The bridge between medical education and clinical practice

Yan-Quan Liu

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Abstract

After perusing the paper by Kim *et al*, I discovered that this is an interesting manuscript and a successful study. Virtual reality (VR) is an emerging and promising technology employed in the domain of medical practice and medical education over the past decade. In the era of big data, VR is constantly progressing in the fields of medical education and clinical diagnosis and treatment. As a novel scientific and technological tool, VR not only overcomes multiple limitations of the traditional medical teaching mode but also reduces the reliance on personnel and equipment. VR can simulate the real clinical situation, stimulate the enthusiasm of young doctors and nurses for clinical study, and simultaneously safeguard and promote medical safety and doctor-patient harmony. Favorable outcomes have been attained in clinical teaching and diagnosis and treatment activities. While enhancing the training conditions of medical cosmetics and elevating the level of clinical practice and teaching, the risks resulting from improper clinical diagnosis and treatment have been circumvented. All of this is evident and comprehensible.

Key Words: Virtual reality; Medical education; Clinical practice; Clinical training; Pedagogy

Core Tip: Virtual reality (VR) is evolving towards networking, intelligence and interactivity in medical education and clinical teaching practice. The application of VR in the medical education domain can effectively render medical education truly an open course that is not confined by time, space and region, can further enhance the favorable outcomes of medical theoretical teaching and clinical practice training, and can drive the reform and innovative development of medical education and clinical teaching practical training, as well as offer new opportunities for the reform and development of medical education. VR serves as an important bridge between medical education and clinical practice.

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TO THE EDITOR

Nowadays, information technology is profoundly integrated with the practical teaching of higher medical education. The emerging digital teaching approach, virtual reality (VR), is evolving in the directions of networking, intelligence, and interactivity in medical education and clinical practice[1]. VR is a type of imaging technology that adopts three-dimensional (3D) interactive logic. With the aid of a computer as a medium, a platform is devised to simulate real scenes, and scenarios that are challenging to experience in reality are simulated and processed. Users can transcend the constraints of time, space, and other objective conditions and engage in the experience and even interaction from the aspects of vision, hearing, and touch. VR possesses the "3I" characteristics, namely, immersion, interactivity, and imagination[2]. VR enables the educated to learn in genuine clinical diagnosis, treatment, and medical practice scenarios and generate corresponding experiences, feelings, and understandings of the actual content, thereby achieving the objective of training learners' learning ability and practical ability. There is no doubt that VR serves as an essential bridge between the theoretical courses of medical education and clinical practice. It can render the teaching of medical courses and clinical practice truly an open course that is not restricted by time and space, further enhance the teaching effect, and facilitate the creation and utilization of a medical education teaching and practice platform with abundant high-quality teaching resources and efficient sharing[3]. VR is expected to promote the reform and innovative development of medical clinical teaching and provide new opportunities for the reform and development of medical education.

Clinical teaching or training is frequently constrained by teaching from textbooks under the medical curriculum standards, understanding and memory of the students, and short-term clinical practice application, which makes it difficult to enhance and stimulate the clinical skills, professional proficiency, personality quality and innovation potential of young doctors and nurses[4]. VR can create realistic and vivid clinical scenarios, enable young doctors and nurses to extract information through visual, auditory, olfactory and other sensory stimulations, immerse themselves in clinical practice and business operations, and allow them to utilize medical knowledge for brainstorming, integrated analysis, and judgment, study and guidance of clinical operations[5]. Correspondingly, in clinical practice, the intelligent feedback system is utilized to evaluate the clinical diagnosis and treatment situation and prognosis of patients, breaking through the constraints of time and space, avoiding ethical and doctor-patient disputes, creating a favorable skills training platform for "beginners", optimizing the allocation of clinical teaching resources, and introducing clinical teaching training and evaluation at a higher level[6].

PRACTICAL BENEFITS OF VR

Furthermore, clinical medicine is a science based on medical theory applied in clinical practice, according to the clinical manifestations of patients, from a holistic perspective, to study the etiological mechanism of diseases and the pathophysiological process of patients, through comprehensive diagnosis, treatment and prevention, in order to restore the health of patients. Through the application of VR in the clinical field, the issue of scarce clinical operation opportunities caused by limited case resources and patients' non-cooperation has been resolved. Through human-computer communication, the perceptual understanding of medical students is deepened, and the doctor-patient communication and adaptability of young doctors and nurses are cultivated to a certain extent[7]. Additionally, VR assists young doctors and nurses in acquiring clinical knowledge, improving the level of clinical skills, and fostering clinical thinking, promotes the reform of medical education, achieves diversification in teaching, research, training, assessment and evaluation, and continuously promotes the innovation and development of the medical personnel training mode[8]. The specific practical advantages of VR are as follows:

Firstly, VR assists medical students in enhancing their learning efficiency and practical skills[9]. By establishing a novel and systematic training space, VR can reproduce clinical situations intuitively, truly, and vividly, enabling medical students to extract information through visual, auditory, and other sensory stimuli and immerse themselves in simulated clinical practice, stimulating their learning interest and improving their practical ability. Simultaneously, VR eliminates the limitation of time and space. Medical students can log into the VR teaching center at any time and anywhere, repeatedly operate and participate in experimental practice, which can fully mobilize the enthusiasm and initiative of

medical students in learning and enhance their learning efficiency. VR experiments or practical teaching can address the issue of limited clinical operation opportunities resulting from limited clinical case data and patients' non-cooperation, and also reduce the waste of medical resources to a certain extent. In the virtual experimental environment, through human-computer communication, students can simulate the diagnosis and treatment of "patients" with real conditions, combine the learned knowledge with practice, and cultivate students' ability to transform knowledge, which not only reinforces the theoretical foundation but also enhances the clinical operation skills. Through deepening students' perceptual understanding, students can also improve their doctor-patient communication ability and adaptability.

Secondly, VR emphasizes the status of medical students and innovates the teaching mode of medical teachers[10,11]. VR adheres to the principal position of students in the learning process and combines multiple novel teaching modes to realize the transformation from "teacher-centered" to "student-centered". Medical students can shift from passive learning to active learning, give full play to the subjective initiative of medical students in basic course learning and clinical practice education, and promote the formation of an active learning mode. In classroom teaching, some students are unable to understand the microscopic experimental process of observation through conventional macroscopic experiments. By designing VR experiments, teachers can fully demonstrate the entire experimental process, realize the digitization and visualization of the experimental process, and enable medical students to have a clearer understanding of the entire experimental process in a short time, concretizing abstract knowledge and significantly improving the teaching quality. The VR project provides vivid and realistic scenes for clinical training and experimental teaching, which greatly enriches the content of practical teaching.

Then, VR optimizes the assessment and evaluation methods of medical specialties to ensure the objectivity and fairness of the assessment[3,4]. Through the real-time score evaluation feedback module of VR, the mastery of knowledge by students can be clearly understood, the learning effect of students can be evaluated, problems existing in teaching can be timely comprehended and discovered, and the next improvement plan can be formulated to truly realize the mutual benefit and win-win situation between teaching and learning. The VR platform can integrate multiple disciplinary experiments into one, make full use of the platform's excellent display function, place the complete basic medical knowledge system on the network platform, and incorporate real clinical cases as guidance, humanistic care, doctor-patient communication, physical appearance, and psychological quality and other aspects into the skills assessment and scoring standards. Thus, comprehensive abilities such as theoretical knowledge, clinical skills, and the combination of doctor-patient communication skills of medical students can be comprehensively evaluated to form a diversified, systematic, and standardized clinical skills training assessment model, objectively evaluate the teaching level of teachers and the learning effect of students, and not only achieve comprehensiveness, objectivity, and innovation of medical training assessment. It can also improve the quality of medical skills teaching and clinical practice training.

Finally, VR enables the open sharing of digital resources to achieve mutual benefit and win-win results[2-4]. Through design optimization and combination, medical colleges and universities can utilize VR technology software to combine high-quality teaching resources, construct various teaching resource sharing platforms, and achieve open sharing of VR teaching resources among universities to achieve optimal integration, dynamic update, and efficient management of teaching resources, which is conducive to promoting the coordinated construction and development of teaching resources within and among universities. It not only improves the teaching quality but also reduces the educational cost of medical practice and realizes the mutual benefit and win-win situation among universities.

LIMITATIONS TO VR AND POSSIBLE SOLUTIONS

As previously stated, with the reform of medical education and the diversified development of clinical teaching practice models, the application prospect of VR in medical education and clinical practice training holds great promise; however, there are also limitations and challenges that cannot be disregarded. Generally speaking, it encompasses the following aspects:

Firstly, the responsibilities of teachers in the medical professional field are not merely as straightforward as course instruction but also entail being accountable for virtual environment management, tutorial arrangements, and other tasks during the process[3,12]. This undoubtedly raises the requirements for teachers' information technology proficiency and capabilities. Some teachers who have not undergone relevant training and received VR technical support and training may encounter difficulties in performing VR clinical teaching duties. To address this, medical colleges or medical institutions should increase training and financial support to ensure that teachers of basic medical courses and clinical practice tutors can master the VR technology platform utilized in the institution. Simultaneously, they should sign relevant technical assistance agreements with VR technology companies to achieve a long-term, effective operational model.

Secondly, virtual patients in the VR medical education platform or VR clinical diagnosis and treatment platform cannot replace real patients[3,12]. Consequently, medical students may overlook communication with patients, preventing the cultivation of students' communication skills. The VR platform or system primarily focuses on technical ability training and cannot enable students to truly sense the discomfort and pain of patients or better cultivate the teamwork ability of medical students. How to enhance the cultivation of humanistic care quality while implementing technology warrants further exploration by researchers. Therefore, medical practice teaching activities cannot rely solely on VR and should by no means substitute the direct contact between doctors and patients. During the process of medical practice teaching, VR should be rationally applied on the basis of the original medical internship and practical training to strengthen practical exercises and effectively cultivate medical students' empathy and doctor-patient communication skills. Naturally, in the construction of the VR teaching project platform, emphasis should be placed on the cooperation among operational

medical students, establishing a group cooperation model, seizing the advantages of group cooperation, strengthening intra-group cooperation, fully promoting exchanges and cooperation among students, and fostering students' teamwork spirit.

Finally, the costs of construction, research and development, and maintenance are high[12]. The equipment and system in the VR teaching platform require significant costs for development and maintenance, including the purchase of new equipment, new program editing, subsequent equipment maintenance, personnel training, and other aspects that demand substantial investment of manpower, materials, and funds. All these may impose certain constraints on VR in medical education and clinical practice. To this end, medical colleges and universities should adopt multiple measures to support the investment in VR in medical education and clinical practice training, strengthen and train professional experimental teaching teams, and encourage college teachers to actively participate in the research and development of VR teaching projects and teaching practice activities. Moreover, by leveraging the advantages of disciplines and professional characteristics, they should achieve the transformation of high-level medical scientific research results into VR teaching content and introduce more mature scientific research technologies and methods in VR practical teaching to complete VR teaching resources.

CONCLUSION

To summarize, I propose that more research on VR should be conducted in clinical or nursing practice research, and greater attention should be paid to the knowledge and application of VR technology among medical groups. In addition, there should be a focus on the promotional role of VR in improving medical technology, enhancing practical skills, upgrading professional ability, improving doctor-patient relationship and satisfaction, avoiding medical professional burnout, enhancing experience and accomplishment, strengthening professional identity and belonging, and personalizing advantages. Simultaneously, scales with high reliability and validity should be developed for investigation, analysis and comparative research. I believe all of this is of great practical importance.

FOOTNOTES

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