

Reform and Exploration of Optimizing Orthopedic Teaching Mode Based on PBL Theory and Virtual Simulation Technology

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How to cite this paper: Wang, W., Wei, J. H., Zhou, H. D., Luo, C. T., Luo, D., Chen, L. C., Yang, W. J., Qin, X. Q., Zhang, W. Z., Huang, S., Xu, J. H., Liu, M. X., & Yu, D. B. (2024). Reform and Exploration of Optimizing Orthopedic Teaching Mode Based on PBL Theory and Virtual Simulation Technology. *Creative Education*, 15, 711-725. <https://doi.org/10.4236/ce.2024.155043>

Received: March 28, 2024

Accepted: May 12, 2024

Published: May 15, 2024

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Abstract

In order to explore the application effect of virtual simulation technology based on PBL concept in the training of clinical content teaching and scientific research ability of undergraduate students in orthopedics, this reform integrates ideological and political teaching and new evaluation system, in order to overcome the limitations of traditional medical clinical teaching, stimulate students' initiative, cultivate students' new learning ideas, and cultivate medical talents with humanistic feelings and medical ethics. This reform takes more than 1000 students of 2023 clinical specialty in our hospital as the research object and is set as the experimental group. PBL teaching mode is adopted throughout the whole teaching process, taking into account the virtual simulation experiment teaching platform project for teachers' explanation, students' self-study and after-school operation practice. Through the real-time feedback information of students' operation provided by the students' skill training feedback system, students are given targeted and personalized guidance training. At the same time, it changes the traditional evaluation system and develops a set of all-round student evaluation system. After class, the students were investigated for classroom teaching satisfaction and skill operation assessment, taking into account the overall performance evaluation. The results were compared with the traditional assessment results of 2022 students (control group), and the differences in scores were observed to judge the application effect of this teaching mode reform.

Keywords

PBL Theory, Virtual Simulation, Orthopaedic Teaching, Ideological and Political Teaching

1. Background

At present, orthopedic medical education is at the intersection of three major opportunities: global scientific and technological revolution, healthy China strategy, and medical education coordination. As an important branch of clinical orthopedics, orthopedics is responsible for the diagnosis and treatment of spinal related diseases, limb trauma, bone disease, sports injury, spinal cord, peripheral nerve and other diseases. Its teaching content covers a wide range; the content is professional and interspersed with each other. This not only requires medical students to have solid basic theoretical knowledge and master certain clinical operation skills, but also needs to cultivate their logical analysis and clinical thinking ability, with good professional quality and professional spirit. Orthopedics is the most difficult subject to learn in the surgical system. In recent years, orthopedics has developed into a more professional and detailed discipline. The corresponding student time has not increased, which makes it difficult for students to get a comprehensive study in a relatively short period of time. At present, clinical teaching is still dominated by teachers' teaching, and students who should be the main body of learning can only passively accept knowledge, lacking the cultivation of independent analysis and problem-solving ability. It can be seen that the traditional orthopedic teaching mode is insufficient for the cultivation of students' clinical thinking ability and practical ability. The teaching quality of orthopedic teachers will directly affect the learning of students' clinical professional knowledge and the cultivation of clinical practice ability. In today's deepening reform of medical education, how to continuously improve teaching methods to help students fully prepare relevant professional knowledge within limited classroom time to achieve the real purpose of practice. In order to improve the quality of orthopedic teaching, adapt to the development of modern teaching, and truly meet the purpose of orthopedic clinical teaching, we continue to explore and reform in teaching.

Problem-based learning (PBL) teaching method was pioneered in 1969 by Barrows, a neurology teacher at McMaster University in Canada. PBL in the Internet environment is a teaching model that has been widely valued internationally (Yang, Wang, Zhu et al., 2023). In 1996, Dolmans found that students acquire scientific knowledge through group problem solving (Nagge, Killeen, & Jennings, 2018), which has been applied and developed in Europe, and then widely used in countries around the world (Ding, Zhang, 2018; Barron, Lambert, Conlon et al., 2008). This model is a student-centered teaching, which revolves around the main line of teachers ask questions-students think and discuss-teachers analyze and solve problems (Liu & Qi, 2019). It is guided by teachers. In the learning process, students can take the initiative to find problems and seek solutions to problems, and actively solve problems by finding literature. In this process, students are the main body of learning, and teachers are only guides. Teachers answer questions in the teaching process, and finally comment and summarize. Students can master knowledge in an all-round way

(Fan, Zhang, & Zhang, 2018). In 1985, Professor Barrows divided the implementation process of PBL into five stages: problem analysis, data collection, information evaluation, summary and timely reflection. In the clinical teaching of traditional orthopedics, teachers are accustomed to using textbooks and PPT to teach, and lack of three-dimensional/three-dimensional display of anatomical structures, which is easy to make students lack a clear understanding of abstract anatomical concepts, resulting in a weakening of interest in orthopedic learning. PBL teaching method can stimulate students' learning potential, strengthen and consolidate knowledge, improve their ability to learn and solve problems, and provide ideas and methods for solving problems in clinical work in the future (Figure 1).

With the development of the times and the progress of science and technology, a series of human research products of 3D digital virtual simulation system have appeared in the medical field. This technology was first introduced into higher education in the United States in the 1990s, and then gradually applied throughout the country. At present, the virtual simulation experiment teaching resources at home and abroad include electronic teaching materials, video, visible and software, etc. (Wang, Hu, & Liu, 2015). Its teaching mode is based on virtual reality. For some experiments that do not have real experimental conditions or are difficult to complete, it relies on a highly simulated mathematical virtual environment to construct experimental operation links, experimental objects, etc., and simulates a variety of scenes in real experimental teaching. Teachers and students can carry out a complete experimental teaching process in the virtual laboratory. The combination of traditional experiments will surely achieve high-quality and efficient experimental teaching and lay a good foundation for cultivating practical and skilled medical talents (Wang, Zhang, & He, 2022). Besides, its effectiveness has also been certified (Li & Xie, 2021; Huang, Xu, Wang et al., 2022; Zhu, Wang, Wang et al., 2022). Virtual simulation

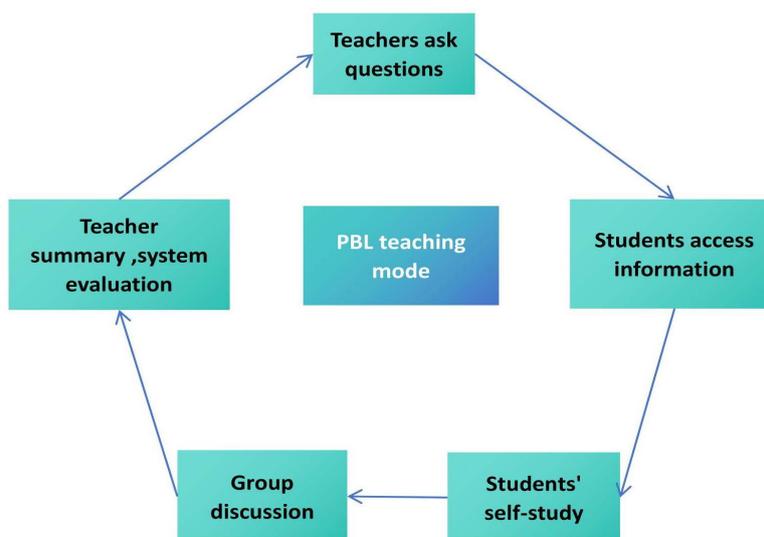


Figure 1. PBL teaching mode diagram.

technology makes up for the shortcomings of traditional teaching methods to a certain extent. It has high plasticity and unique human-computer interaction, which makes the teaching process more interesting. It changes the traditional single teaching method, and has strong operability and no time limit. Secondly, virtual simulation technology can combine theory and practice closely, and can present the dynamic experimental content on the terminal display, and then display the accurate position of each organ and tissue from multiple levels and angles. It is vivid and intuitive, and brings students the real feeling of clinical practice and demonstration of human activity law, which can improve the teaching quality of clinical teaching (Zhou, Ma, Zhang et al., 2019; Mackay, Anderson, & Harding, 2017). Virtual simulation experiment teaching can be completed by computer and mobile phone. It is easy to operate and flexible. It can complete learning anytime and anywhere in classrooms, dormitories, families and other places. It can communicate with teachers at any time and is not limited by time and space. At the same time, the virtual simulation experiment can be operated repeatedly, and the experimental operation and process can be mastered many times, so as to improve the learning efficiency and save the teaching time (Figure 2). Clinically, virtual simulation technology is used for teaching, as shown in Figure 3.

The new teaching mode of PBL combined with virtual simulation is of great necessity for clinical undergraduate teaching. Taking orthopedic teaching as an example, different from the lack of initiative in traditional cramming education, PBL can be introduced into teaching according to the characteristics of cases, and a case-guided teaching method can be designed. Based on the problem, the actual cases in the clinic are introduced into the clinical teaching, combined with the outline knowledge, which can give full play to the advantages of teaching and

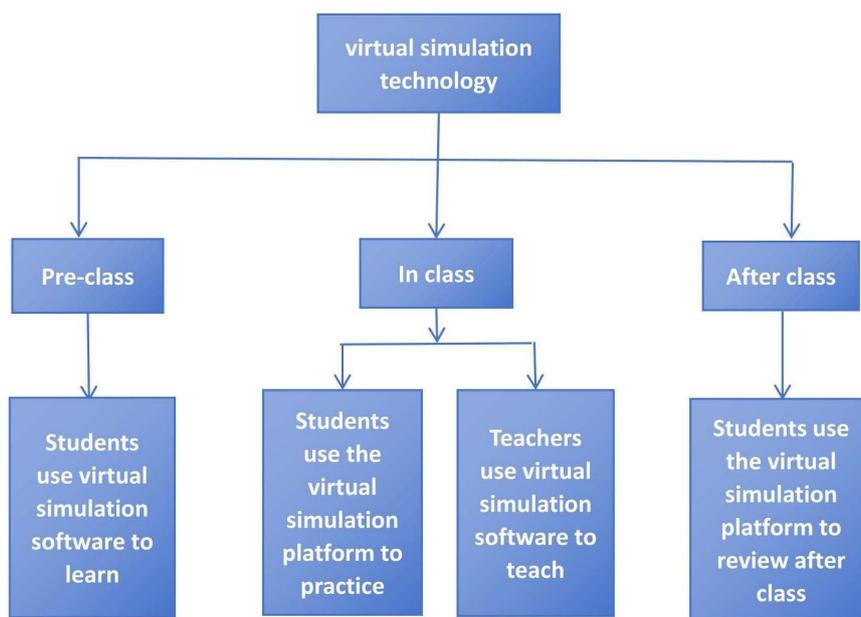


Figure 2. The teaching application of virtual simulation technology.



Figure 3. Clinical application of virtual simulation technology.

give full play to the initiative of teachers and students, so as to improve the quality of teaching and cultivate students' comprehensive ability. At the same time, combined with the hot technology virtual simulation system, through the simulation of various senses such as hearing, vision and touch, a new bridge is built for teaching and clinical practice while improving the interest of learning and teaching, improving students' interest in learning and increasing students' learning initiative. The cultivation process of students in the new era not only has the cultivation of professional knowledge and practical ability, but also integrates ideological and political teaching to pay attention to the guidance of students' ideology, morality and values, so that the effect of students' education guidance will be better. In this mode, clinical teaching and scientific research ability training are carried out, and students' scientific research design, scientific research practice, data processing and thesis writing ability are improved, thus improving their scientific research ability. Virtual simulation technology can solve the shortcomings of long experimental period, complex process and expensive equipment, save training cost and speed up the experimental process. At the same time, it can reduce the risk of experiments, eliminate hidden dangers of dangerous reagents, further strengthen safety education, ensure personal and experimental safety, and help students overcome fear psychological barriers. Virtual teaching can be completed by computer and mobile phone, which is not limited by space and time, and greatly improves the learning efficiency. For the teacher team, teaching activities are a dynamic process, based on the principle of continuous improvement. The new teaching method is conducive to continuously improving teachers' teaching awareness and teaching level, promoting the transformation of teachers from passive teaching to active teaching, and further improving the ability of teachers' team.

2. The Problems of Traditional Orthopedic Clinical Teaching Mode

1) The Teaching Method is Thin

At present, in the clinical teaching of orthopedics, classroom teaching is still the dominant teaching mode. The traditional teaching mode mostly depends on the on-site teaching of teachers, teaching materials and multimedia text and picture descriptions, but lacks the presentation of three-dimensional structure

and the display of specific operation videos. Students lack a clear understanding of abstract concepts, which leads to a deviation in understanding the details of concepts and skills and affects the teaching effect. The output of textbooks is often boring, and students often have rejection or even weariness. How to improve the interest of orthopedic teaching is a topic in front of every orthopedic teacher. The traditional teaching mode ignores the training of medical students' practical ability, which is easy to cause the disconnection between theory and practice. There are many unsuitable situations after medical students enter the clinic. How to effectively improve students' practical ability and provide more practical opportunities has also become a problem faced by traditional education.

2) Weak Thinking Ability Single

The traditional passive teaching mode is single, which is not conducive to mobilizing students' enthusiasm for learning, and students' self-learning ability is not strong. Students' clinical thinking lacks systematicness, and there are problems such as one-sidedness, passivity, and confusion. At the same time, many students have no scientific research energy in their undergraduate study, which is very unfavorable for future employment or examinations. The cultivation of scientific research ability in the department stage is not only the requirement of the times, but also the basic guarantee of the quality of higher-level personnel training. For medical students, the undergraduate study period is an important stage to cultivate scientific research thinking.

3) Insufficient Evaluation System

At present, the traditional teacher's evaluation system for students is still based on test scores, and there are often drawbacks in the single result. This method of using test scores or test scores as evaluation criteria often cannot objectively reflect students' learning ability and effect, and cannot form effective feedback and improve the teaching process.

4) Lack of Ideological and Political Education

The construction of curriculum ideological and political system is the basic guiding requirement of higher vocational talents training in the new era, and the basic premise to ensure that students' ideological and political quality meets the requirements of socialist construction talents training in the new era. The traditional orthopedic teaching process focuses on the teaching of theoretical knowledge and the cultivation of practical ability, and often ignores the medical humanities and ideological and political education. This leads to the disconnection between professional basic knowledge, skill education and ideological and political quality education, which affects the professional information and medical ethics of medical students, is not conducive to the cultivation of medical students' humanistic care ability and professional quality, and is difficult to achieve the situation of all-staff education and whole-process education.

5) Low Practical Ability

In recent years, with the standardized training, a large number of "training" and professional graduate students' have entered clinical practice, which has

brought a great impact on the clinical practice of undergraduates. The effect of clinical practice cannot meet the requirements of practice. The practical teaching of orthopedics is one of the important links in the study of clinical orthopedic medical students. The traditional teaching mode ignores the training of medical students' practical ability, which is easy to cause the disconnection between theory and practice. There are many unsuitable situations after medical students enter the clinic. How to effectively improve students' practical ability and provide more practical opportunities has also become a problem faced by traditional education.

6) Low Utilization Rate of Specimens

The teaching content of orthopedic anatomy is numerous and the structure is complex. Due to the lack of students' practical ability, the teaching experiment has certain destructiveness and irreversibility to the specimen, and there are problems such as low utilization rate of the specimen, which seriously wastes the specimen. For example, the anatomy of some parts has the problem that the area is getting smaller and the position is getting deeper and deeper. The difficulty of identification in the process of anatomy and the small operating space lead to irreversible damage to the tissue structure of the specimen during the actual operation of the students.

3. The Goal of Teaching Reform

The goal of this teaching reform is to change the disadvantages of the traditional orthopedic teaching mode. Based on the PBL theory, the teaching mode is changed from knowledge dissemination to clinical ability training, so as to improve students' in-depth understanding of clinical practice and exercise their scientific research ability. Combined with virtual simulation technology, it highly restores the real situation, effectively improves the traditional boring single teaching status, and improves learning efficiency. Integrating ideological and political elements into teaching can help students establish correct three views and cultivate correct professional beliefs, which is helpful to cultivate critical and innovative thinking of medical students. At the same time, teachers evaluate students from many aspects by establishing a diversified teaching evaluation system, which is more objective and public while improving students' self-examination consciousness and promoting the operation of comprehensive abilities such as clinical thinking and practical application. At the same time, this education reform also has the policy support of the school. The school has a good teaching environment and the foundation of first-class discipline construction. At the same time, it also has an excellent teaching team of the scientific research section. The teaching and research section has carried out theoretical courses and probation practice, and has achieved certain results. The members of the teacher team are composed of teachers with rich teaching experience. The age and professional title structure of the members of the research group are reasonable, the professional foundation is solid, the ideological and political is excellent, and the teach-

ing and teaching reform work experience is rich. The applicant project team has also undertaken a number of scientific research projects, and has experience in teaching reform, which has laid a good foundation for the teaching reform under the combination mode of PBL and virtual simulation technology. The specific reform measures are as follows:

1) Change the teaching mode and establish a multi-evaluation system

Teachers prepare lessons collectively, use PBL theory as a guide supplemented by virtual simulation technology to explain the course, and impart obscure knowledge to students with maximum efficiency. The PBL model adopts question-based teaching. Students learn by themselves according to the questions raised by teachers and then get conclusions through group discussions, reducing unilateral teacher explanations and improving students' teaching inspiration, initiative and creativity. Combined with virtual simulation teaching, the relevant content is learned in advance in the multi-functional terminal equipment. In the classroom, students answer the tasks assigned by the teacher in advance, discuss collectively and get the results, and finally review through simulation software after class. Operational projects can be operated through computer-side virtual scenes, such as orthopedic surgery operation exercises to cultivate students' hands-on ability. Through repeated practice analysis, the specific steps and best forms of the application of virtual simulation technology teaching mode based on PBL theory are explored.

The traditional orthopedic teaching only uses the final grade to test, this evaluation method cannot objectively evaluate the students' comprehensive ability. Establish a diversified evaluation system, which is divided into teacher evaluation, student mutual evaluation and student self-evaluation. The teacher evaluation is divided into pre-class evaluation and classroom evaluation. The pre-class evaluation is mainly the completion of preview content and exercises. The classroom evaluation is whether the students are serious in the classroom, whether they get flexible answers according to the cases provided by the teacher, and whether they have a clear mind map and method steps for the cases. This kind of assessment method requires students to focus on each classroom and accumulate their usual achievements, avoiding memorizing theoretical knowledge at the end of the semester, and truly paying attention to the cultivation of students' ability. Students' mutual evaluation can be carried out within the group and supervise each other's learning efficiency. Students' self-assessment is students' self-reflection summary. The diversified teaching evaluation system is conducive to the high efficiency of the overall learning and teaching direction.

2) Strengthen the cultivation of students' ideological and political construction and scientific research ability

Strengthen the ideological and political construction of teachers and students, and constantly reflect on self-behavior in work and study. Keep awake at all times, high standards for themselves, and strive to become a comprehensive clinical professional, ready to adapt to future work needs and work progress. For ideo-

logical and political education, it can be integrated into daily learning and communication, and it is stipulated that the department must carry out ideological and political theme education every week to promote the progress of thought.

To create a good scientific research atmosphere among medical students requires the joint efforts of schools and students. Regularly carry out scientific research training, encourage students to establish scientific research teams, and apply for innovative projects to strengthen students' participation and create a positive scientific research atmosphere. Reform the relevant training system, lead students to carry out scientific research, use the virtual simulation technology platform, shorten the research experiment practice, accelerate the research process, and increase the scientific research results.

4. Implementation Strategy

Select clinical undergraduate students to form a learning team and establish a team level, including curriculum guidance, teacher team and student team. According to the analysis of the students' situation, the collective orthopedic teachers are familiar with PBL and virtual simulation technology to formulate teaching objectives and formulate feasible training programs based on clinical cases. Teachers carry out regular training to improve teaching ability, unify teaching standards, and formulate relevant assessment and scoring standards. Train students to make them familiar with PBL and virtual simulation, understand and accept the teaching mode, and build a good teaching community. The director of the surgical teaching and research section and the members of the project team strictly check and formulate a series of relevant rules and regulations for undergraduate teaching activities to ensure that all aspects of teaching activities are carried out in a standardized and smooth manner, so as to effectively improve the students' ability to combine theory with practice. On the basis of mastering the diagnosis, identification and treatment of various common orthopedic diseases required by the teaching objectives, students also have a deeper understanding of the scientific research writing of clinical medical papers and the common surgical skills, and expand the frontier knowledge of medicine, so as to cultivate their clinical thinking and practice, teamwork, doctor-patient communication and other abilities.

1) Clinical teaching

Teachers need to reconstruct the teaching content, assign the teaching content of each chapter to the problem, select clinical cases, and design different emphases according to the teaching objectives. Case problems run through the classroom. Starting from the course problem directly, the practical operation is carried out according to the case problem-analysis solution or step-virtual simulation platform. All the teaching links are based on the cases provided by the teachers. Before the class, the teacher carefully prepared the lesson according to the outline, sent the clinical data of the selected typical cases to the group leader, and asked questions according to the selected typical cases, such as the anatomi-

cal structure involved in the anterior cruciate ligament injury and the surgical treatment method, while avoiding the blindness of the students' preview.

Students learn in groups, take the initiative to learn the knowledge of textbooks and orthopedic professional books, and seriously consider and consult the literature. Each group sent a representative to provide the answers to the questions decided by the group and make the corresponding understanding and analysis of the cases in their own group.

The teacher summarizes the answers of each group, and grasps the weaknesses of students' understanding of the case, and grasps the key points that need to be explained. According to the carefully designed teaching content, combined with the virtual simulation 3D software, the teacher explains the answers according to the key and difficult points, and completes the teaching task in a limited time. Teachers can design interesting teaching methods in combination with virtual simulation in the comments, and use animation, video, PPT and other teaching aids to make the learning content easy to understand, so as to produce good teaching results.

In the rest of the class, students can use simulation software to learn, and 3D digital virtual simulation technology software can be used to learn the corresponding anatomical structure on the mobile phone computer to understand the anatomical structure of muscles, bones, ligaments, nerves and so on. Students use the virtual experimental platform to carry out practical exercises of surgery, and cultivate students' ability to practice, analyze and solve problems. Students carry out repeated training through simulated teaching equipment to master the basic steps and processes of each clinical operation, improve students' awareness of aseptic operation, and enhance their sense of teamwork. After the students complete the simulation, the problems encountered by the students are collected and discussed again, and the simulation is carried out again to solve the problems encountered in the initial simulation. The teacher uses the uniqueness of the student number to monitor the students' learning progress and knowledge points in real time.

2) Enhancement of scientific research ability

In order to enhance students' writing ability of scientific research papers, teachers put forward five core scientific research topics after consulting literature and consulting experts. Questions are asked by teachers: What are the main themes and secondary themes of this topic? How to choose the research object? What kind of research methods, data collection methods and statistical methods are used? What are the current research questions? What is the current situation of related research at home and abroad? The research topics and questions were published by the WeChat group of the student research group and selected by the group.

In terms of improving scientific research ability, after the team members selected the theme, the tasks were refined and allocated. According to the assigned tasks, the team members consulted relevant literature at home and abroad through

various methods such as literature database and questions. During this period, the research group, through the combination of online and offline, was urged by the instructor to consult the literature and read the literature, and to answer the problems encountered by the students in reading the literature. The team members established an online discussion group through WeChat, Tencent Conference and QQ, shared the data and information they consulted, integrated and summarized the data, and made them into slides. The team showed the team's results, and one representative was selected from each group to report. The content of the report focused on the research status and progress of the selected topic, the relationship with the clinic, the current unresolved problems, and the understanding and thinking of the team members.

After the end of the report, the group discussion and questions were asked, and the instructor gave timely guidance during the process. And help solve the problems encountered. The group leader organizes the discussion according to the problem, each person expresses his opinion according to his own learning achievement data, and the group discussion draws the final conclusion.

Then students use the virtual simulation platform to carry out scientific research experiments. In the virtual simulation experiment project, students can enter the virtual laboratory scene immersively from the first perspective. The experiment involves the safe operation of common instruments and equipment in the general biology laboratory, the safe operation and treatment of dangerous reagents, the laboratory safety specifications and hidden dangers, and the emergency treatment of related emergencies. Train and examine students' active safety awareness and operational skills. The application of virtual simulation technology in scientific research and technical operation is shown in **Figure 4**.

3) Review and evaluation

After the end of the course, the students reviewed the anatomy or surgical techniques according to the simulation software of the mobile phone or computer. At the same time, the virtual platform can be used to familiarize and consolidate scientific research experiments. Teachers make overall comments, including students' classroom performance, learning attitude, operational skills, etc., as well as the completion of pre-class tasks and the ability of thinking and scientific research to guide students not only to master professional knowledge, but also to learn the cultivation of basic skills practice and the cultivation of



Figure 4. The application of virtual simulation technology in scientific research.

ideology and morality, and to formulate appropriate effect evaluation indicators and methods. Scientific research thinking ability requires students to put forward scientific problems, draw up technical roadmap and use experimental methods to investigate students' scientific research thinking ability according to scientific research topics and literature reading. Mutual evaluation and self-evaluation among students are carried out to fill in the gaps in learning and improve the ability of self-reflection. In the evaluation subject, it includes three participants: teachers, students and teaching and research sections. Comprehensive evaluation can be carried out by means of student evaluation, peer teacher evaluation, teacher self-reflection, teaching and research section supervision, etc. At the same time, strict assessment and scoring standards are formulated to minimize the phenomenon of fuzzy evaluation and unfair evaluation results, and the strategy and feedback system of formative evaluation are constructed. It has the characteristics of advanced, comprehensive, systematic and complete combination. Compare the evaluation results with the traditional teaching evaluation results of the 2022 level, and observe whether there is a difference between the two. Besides, investigate students' satisfaction with the teaching mode.

4) Encourage students to cultivate scientific research ability

Arrange small lectures, scientific research lectures, etc. in the school period of orthopedic medical students, including paper writing and scientific research fund declaration and opening report format specifications and paper writing methods, and give teachers guidance. Students form five scientific research training groups in a free combination of free students, with seven students in each group and one professional instructor. The group leader is responsible for the system and the team members work together. First, organize more than two scientific research trainings per month, so that medical students interested in scientific research can get effective scientific research guidance. Second, students can be encouraged to establish scientific research teams of different majors, which can play a good leading role and encourage students to communicate more with each other. At the same time, we should improve the innovation incentive mechanism, encourage undergraduate scientific research teams to apply for innovative projects, give certain rewards to approved projects, strengthen students' participation, and create a positive atmosphere for scientific research and innovation.

5) Integrating ideological and political content into teaching

Ideological and political education is integrated into every link of teaching reform, and ideological and political theme education is carried out every week to promote ideological progress. Undergraduate is the transition of students from theory to practice, and the integration of ideological and political teaching can improve students' professional quality. Regularly organize orthopedic medical humanities education, doctor-patient communication skills, establish a correct professional outlook, and cultivate medical talents with humanistic feelings and medical ethics. At the same time, the content of curriculum ideological and

political education is integrated into the diversified evaluation system, and a more scientific and reasonable orthopedic teaching evaluation system with ideological and political elements is designed to evaluate the students' orthopedic learning process in multiple dimensions, which is conducive to improving the students' learning quality and is of great significance to ensure the quality of medical personnel training.

5. Conclusion

Based on the PBL teaching mode and the integration of virtual simulation technology into each teaching link, there is no report on the teaching of orthopedics for medical students in clinical practice. Based on the characteristics of orthopedic teaching courses, this project studies how to construct the clinical teaching system of orthopedics under PBL theory, which is helpful to the cultivation of students' clinical thinking and the improvement of practical skills, so as to make it a systematic and innovative clinical thinking. In this paper, virtual simulation technology is integrated into teaching, and the traditional cramming teaching mode is changed. It lays a foundation for cultivating medical talents with practical clinical skills, innovative scientific spirit and divergent thinking to find problems. It is an innovation in research content. According to the key and difficult points of orthopedic teaching content, this project designs the teaching objectives in the school, specifies the implementation methods according to the orthopedic professional situation, and optimizes the evaluation system. This method is conducive to stimulating students' active learning ability, establishing students' dominant position in learning, and the teaching method and teaching reform mode are novel. Integrating ideological and political education into undergraduate teaching highlights the importance of student education in our school, and puts forward the requirements and expectations of cultivating all-round development talents. Specific to political thought, we should pay attention to the cultivation of students' professional quality, exercise their ability of humanistic care, and help cultivate compound medical talents. It is of great benefit to the future undergraduates to continue their studies or to enter clinical work. If the project can be successfully implemented, it will benefit a large number of medical students every year. When the teaching mode is mature, it will be extended to other medical colleges to eliminate the deviation under different educational and cultural backgrounds, in order to benefit more students. However, the reform model also has some limitations. The teaching method of this model may ignore the nuances of some students' individual learning preferences and needs. There is a lack of detailed exploration on how this model supports students with different learning speeds and learning styles. In addition, the virtual simulation technology experiment platform may require a lot of investment, and how to ensure the rational allocation of teaching resources also needs to be carefully planned. In order for teachers to effectively bring PBL combined with virtual simulation technology into teaching, regular training is also essential,

which may bring additional challenges. Therefore, the reform of this teaching mode requires the teaching group to gradually explore in the follow-up research, adapt to the development of modern teaching, improve the quality of orthopedic teaching, and truly meet the purpose of orthopedic clinical teaching. We need to constantly explore in teaching.

Funding

2023 Guangxi Higher Education Undergraduate Teaching Reform Project (2023JGA275); 2023 Research Project on Education and Teaching Reform (JGZLC2023-11); 2022 Degree and Graduate Education Reform Topics (JGY2022282).

Conflicts of Interest

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

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