

Analysis of the Application Strategy of Multi-dimensional Teaching Mode in Orthopedic Teaching

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Abstract: Orthopedics is a field characterized by its strong practical application. Traditional clinical teaching methods in orthopedics show significant limitations in meeting the demands of modern medical education, including outdated philosophies and a lack of flexibility in instructional design. These challenges make it difficult to significantly enhance the quality of orthopedic teaching. In contrast, the multi-dimensional teaching approach promotes active learning among students. It utilizes diverse educational resources and incorporates various teaching styles from different instructors. This method enhances students' comprehensive skills while increasing instructional adaptability, aligning with the reform needs in orthopedic education. Based on this, the article provides a concise overview of the benefits of the multi-dimensional teaching model, examines the drawbacks of conventional teaching methods, and proposes targeted teaching strategies to serve as a valuable reference for relevant educators.

Keywords: Multi-dimensional teaching; Orthopedics; Teaching strategies

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1. Introduction

Orthopedics represents a crucial field within modern medicine, encompassing areas such as the musculoskeletal system, neurovascular components, and more. It is characterized by its strong emphasis on practical application and interdisciplinary integration. Although educational reforms are gradually transforming orthopedic teaching methods with some success, changing traditional teaching concepts and models is still a slow process. Numerous challenges persist in the instruction of clinical skills within orthopedics. Finding ways to facilitate the transition and advancement of conventional teaching management approaches, while innovating the clinical skills teaching model in orthopedics, presents a significant challenge for medical schools. The implementation of a multi-dimensional teaching approach in orthopedic education can effectively address the limitations of traditional methods and accommodate the diverse learning requirements of students. Additionally, this approach aids in cultivating highly skilled orthopedic professionals capable of adapting to advancements in modern medicine.

Therefore, exploring strategies to implement multi-dimensional teaching modes in orthopedic education is of significant practical importance.

2. The advantages of a multi-dimensional teaching mode

2.1. Stimulate learning interest and initiative

The traditional teaching approach, often called “full classroom instruction,” can disengage students. In contrast, the multi-dimensional teaching model can boost students’ interest and motivation through various instructional techniques. Educators increasingly integrate new teaching strategies, such as case-based learning (CBL) and problem-based learning (PBL), into orthopedic clinical education. Additionally, advancements in technology, such as 3D printing and virtual reality, are being increasingly used in medical education. This technological integration drives the evolution of teaching methodologies, enabling instructors to create dynamic and innovative learning environments that boost student engagement and enthusiasm ^[1]. Within this framework, teachers can establish effective and creative classrooms to foster active participation and a deeper interest in learning among students ^[2].

2.2. Improve practical ability

Orthopedics is a field characterized by its strong practical application. Implementing a multi-dimensional teaching approach allows for the integration of various strengths, thereby enhancing the effectiveness of clinical skills education in orthopedics ^[3]. For instance, leveraging virtual simulation technology to recreate surgical scenarios for students, such as hip replacements or spinal surgeries, provides them with hands-on experience. Within this virtual environment, students can practice and refine their surgical techniques, improving both precision and proficiency. Additionally, collaborative clinical practice initiatives between schools and hospitals offer students direct exposure to real-world patient care and involvement in actual diagnostic and treatment processes ^[4]. Supervised by experienced physicians, students participate in activities such as gathering medical histories, conducting physical examinations, and analyzing test results. These experiences collectively enhance their clinical competency through practical application.

2.3. Promote personalized development

Every student has unique traits that require different learning pathways. Various teaching methods can meet students’ needs and support their personalized growth. For example, students who like watching videos and have strong comprehension skills can benefit from multimedia resources such as videos and animations. These resources help them acquire knowledge and reinforce their memory. Students with strong logical reasoning can benefit from the PBL teaching approach and group discussions. This allows them to use their strengths to tackle complex clinical issues and engage in collaborative discourse, thereby deepening their thinking ^[5]. Additionally, online teaching resources provide extensive content, allowing students to choose topics and schedules that match their learning pace and interests. Those with exceptional learning capabilities can utilize online courses and medical databases for in-depth study and to broaden their perspectives.

3. Disadvantages of the traditional orthopedic teaching mode

3.1. Single teaching method

In orthopedic education, the predominant teaching approach relies on a “full-class instruction” model. This means

that instructors deliver lessons based on textbook material within the classroom setting, while students remain passive recipients of the information. Although teachers provide extensive content, the results of this instruction often do not meet expectations ^[6]. Relying solely on verbal explanations from the instructor, coupled with basic visual aids and textual descriptions, makes it challenging for students to gain an intuitive understanding or practical command of the subject matter. Consequently, students find it difficult to comprehend and master relevant knowledge. Over time, this teaching style can restrict students' thought processes, diminishing their capacity for independent thinking and innovation. Additionally, the lack of diversity in teaching methods fails to accommodate the varied learning needs of individual students. Consequently, some learners may develop resistance toward orthopedic studies, further impacting the overall effectiveness of the instruction.

3.2. Disconnection between theory and practice

In the conventional teaching model, a significant gap exists between theoretical instruction and clinical application. The knowledge students acquire in class primarily focuses on the causes, pathology, diagnostic criteria, and other theoretical aspects of orthopedic conditions involving functional impairments, which often lacks direct relevance to real-world clinical scenarios. Upon transitioning to the clinical practice phase, students frequently struggle to effectively apply their theoretical understanding to practical patient care situations ^[7]. In lectures, they study the fundamental principles, procedural steps, and key considerations of surgical techniques; however, when exposed to actual surgical environments and procedures in clinical settings, they realize that there is a considerable discrepancy between what they have learned and real-life applications. This disconnect between teaching philosophy and methods hinders students' practical skill development and reduces their ability to understand and retain knowledge.

3.3. Ignoring students' individual needs

Every student has unique interests, preferences, and learning capabilities. However, the traditional teaching model in orthopedics often uses standardized materials and methods that do not meet students' individual needs, such as adapting resources for different learning styles ^[8]. For students with advanced learning abilities, the uniform teaching pace may make the content too simplistic, hindering their potential. In contrast, students with weaker foundations or slower learning speeds may lose confidence because they struggle to keep up with the pace of instruction. These disparities make it difficult for the traditional teaching model to provide personalized instruction, resulting in inconsistent learning outcomes for students.

4. The application strategies of multi-dimensional teaching mode in orthopedic teaching

4.1. Rely on multimedia platform, integrate multimedia teaching resources

4.1.1. Integrate 3D models and animation demonstrations

In orthopedic education, using 3D technology to showcase bone anatomy and surgical procedures provides students with a clear, three-dimensional view that greatly improves their understanding of complex orthopedic concepts ^[9]. For example, traditional two-dimensional images or text often fail to help students understand the spine's three-dimensional structure, the connections between vertebrae, and how nerves and vessels are arranged in the spinal canal. With a 3D model, students can examine the spine from all angles, clearly identifying the shape and dimensions of the vertebrae, the location and function of the intervertebral discs, and the path of the

spinal cord through the canal. When teaching about fracture surgeries, instructors can use 3D animations for demonstrations. For example, when demonstrating intramedullary nailing for femoral fractures, animations can show each step of the procedure sequentially ^[10]. This allows students to observe how surgical instruments are manipulated and how the fractured area evolves throughout the process. Such an interactive approach enhances students' understanding of surgical techniques and facilitates their mastery of essential principles and skills.

4.1.2. Introduce videos of typical cases

In educational practice, instructors can utilize real-life case videos to lead students in analysis and discussion, thereby enhancing their clinical reasoning skills. Instructors can select representative orthopedic case videos, such as those involving cervical spondylosis, lumbar disc herniation, or knee replacement, to present in class. While the videos play, instructors can pause at key moments to ask relevant questions and encourage students to think critically and analyze the content. For example, instructors can ask students to determine the preliminary diagnosis from the patient's symptoms shown in the video. They can also identify the rationale for the diagnosis and suggest the necessary tests to confirm it. This approach enables students to apply their acquired knowledge in analyzing and assessing the cases presented ^[11].

After the video ends, have students participate in a group discussion. Each group should conduct a detailed analysis of the case, exploring the disease's causes, pathophysiology, diagnostic criteria, treatment strategies, and potential complications. Following the group discussions, select representatives from each group to present their findings and share the outcomes of their discussions. Based on the presentations, instructors provide feedback and summaries, assist students in rectifying any misconceptions, fill in any knowledge gaps, and guide them in developing appropriate clinical reasoning skills.

4.2. Combine CBL and PBL teaching method to cultivate students' problem-solving ability

The CBL teaching approach emphasizes case-based learning through real-world examples. In orthopedic education, the CBL method enables students to analyze complex cases, enhancing their clinical reasoning skills. Conversely, the PBL approach promotes independent exploration through problem scenarios, developing students' problem-solving skills ^[12]. Each method has unique features and benefits; by integrating CBL and PBL, educators can enhance students' skills in case analysis, critical thinking, independent learning, and teamwork, promoting their overall development. For example, an instructor could present a complex joint condition case involving a 65-year-old patient named Xu. This patient suffers from cerebral palsy, congenital left hip dislocation causing a shortening of the left lower limb by 8 cm, abnormal gait due to heightened muscle tension in both the upper and lower left limbs, and chronic lameness affecting weight-bearing in the right lower limb. The left hip joint remains fixed in flexion, unable to extend, leading to a decline in quality of life. The teacher could then pose questions related to the pathophysiology and treatment options for the patient's right knee joint, whether surgical replacement is appropriate, and potential complications. Additionally, discussions could include treatment strategies and possible complications for the left hip joint, as well as recommendations for positioning during early postoperative rehabilitation, methods for getting in and out of bed, and techniques to stabilize the replaced joint.

By engaging with case patients through interaction and communication, students gain an understanding and mastery of the contralateral knee joint injuries that can occur in patients with unilateral hip joint issues. Furthermore, by examining the specific features of unilateral knee conditions and contralateral hip replacements, students are encouraged to explore how these conditions progress and to investigate possible clinical solutions.

This method provides a well-rounded and immediate learning experience, improving students' knowledge and skills in rehabilitation practice.

In clinical education, instructors gather and organize representative rehabilitation cases, further developing and elaborating on them based on the content covered in specific teaching units. These cases are then thoroughly analyzed and discussed in an engaging, immersive setting, focusing on the hallmark symptoms and dysfunctions of patients. This method connects students' basic theoretical knowledge with real clinical situations, boosting their interest in clinical studies. Within this immersive classroom environment, learners interact with case subjects, enabling a comprehensive, multi-faceted, and real-time understanding of clinical practice. Through this process, students achieve the objective of integrating theoretical knowledge with practical application.

4.3. Implement situational teaching methods and strengthen practical training

4.3.1. Create realistic teaching situations to enrich students' practical experience

The situational teaching approach is important because it creates a realistic teaching environment that strengthens interactions and allows students to improve their vocational skills through role-playing and simulations^[13]. The Orthopedics department plays a crucial role in hospitals. Exploring diverse and scientific teaching methods can greatly enhance students' skills and produce more competent healthcare professionals. By developing virtual scenarios, students can effectively engage with professional knowledge and skills, helping them become more familiar and proficient.

For instance, a simulated operating room can offer students a realistic operational environment, enabling them to practice procedures safely while gaining invaluable experience. This simulated setting is equipped with a comprehensive range of surgical tools, mock operating tables, and realistic human models, which together create an authentic surgical environment. Within this environment, students can perform simulation exercises for various orthopedic procedures, including fracture reduction, internal fixation, implantation, and joint replacement. By repeatedly engaging in these simulated surgeries, students can progressively become acquainted with the procedural steps, enhancing both their skill level and precision in surgical techniques, which ultimately prepares them for future clinical operations.

4.3.2. Increase the investment in practical teaching and build clinical skills training center

A clinical skills training center should have advanced equipment and resources to conduct diverse orthopedic skill trainings, thereby enhancing students' operational proficiency. The center should include equipment such as orthopedic traction beds, plaster fixation models, and joint motion measurement instruments. Students can practice skills like fracture traction, plaster fixation, and joint function evaluation in this environment^[14]. For instance, the clinical training center provides skin traction and bone traction equipment and models, enabling students to understand various fracture types, locations, and conditions. They can learn different traction techniques, determine appropriate weights, angles, and traction durations, and grasp the nursing essentials during skin and bone traction processes. Through structured training at the clinical skills training center, students can learn essential orthopedic skills, enhance their practical abilities, and prepare for future clinical practice and employment.

4.4. Carry out project-based learning and strengthen group cooperation

Instructors can assign challenging group projects, such as creating a diagnostic and treatment plan for an orthopedic condition, simulating orthopedic surgery, or conducting an epidemiological study on orthopedic

diseases^[15]. For example, teachers might select patients with femoral neck or intertrochanteric fractures as case studies before the instruction begins. In small groups, students manage various cases and develop suitable care plans for each patient. Before teaching sessions begin, instructors should explain to both groups how to gather patient information, which includes chief complaints, medical history, and auxiliary examinations for each case. Throughout the project, team members must collaborate regularly, sharing updates and insights, applying learned knowledge to manage patient conditions, and collectively refining treatment strategies for later stages. Ultimately, each group presents its findings to enhance students' independent learning skills and clinical reasoning abilities. Throughout this process, educators can use interactive 3D models and animations to explain the anatomical structures surrounding the hip joint. This approach helps students review key concepts and encourages them to explore similarities between fractures in different areas of the body^[16]. Additionally, based on physiological structures, the causes, classifications, and diagnostic methods for femoral neck and intertrochanteric fractures are explored, culminating in a summary of treatments for these two prevalent hip fractures.

5. Conclusion

In summary, diagnosing and treating orthopedic conditions is a multifaceted challenge that underscores the importance of innovative educational approaches in shaping the future of orthopedic professionals. Integrating various three-dimensional educational methods in orthopedic education, alongside fields like pharmacology and surgery, greatly improves teaching quality and helps develop highly skilled orthopedic professionals. Educators in this field should consistently innovate and refine their teaching strategies, optimize the teaching framework, and align it with clinical practice to provide students with effective and high-quality educational experiences. Furthermore, promoting interdisciplinary collaboration by integrating advanced technologies and ideas from various fields is essential. This approach not only broadens students' knowledge and perspectives but also nurtures orthopedic specialists with innovative mindsets and comprehensive skills, effectively meeting the evolving demands of modern medicine.

Disclosure statement

The author declares no conflict of interest.

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