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Application Research of Digital Human Virtual Anatomy System in the Teaching of "Human Computed Tomography Anatomy"

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Abstract: Objective This study aims to explore the application effect of the digital human virtual anatomy system in the teaching of "Human Computed Tomography Anatomy." Methods Students from the Medical Imaging major of the School of Medical Technology, Xi'an University of Chinese Medicine, from the 2019 and 2020 cohorts, were selected as the research subjects. They were divided into a control group (n=113) and a study group (n=124). The control group received conventional teaching methods, while the study group utilized the digital human virtual anatomy system for instructional purposes. The teaching effects were compared between the two groups. Results The study group achieved higher scores in theoretical assessments, skill assessments, completion of assignments, and participation compared to the control group, with statistically significant differences ($P<0.05$). Conclusion The teaching reform based on the digital human virtual anatomy system is beneficial for cultivating students' learning and problem-solving abilities. It demonstrates significant teaching effectiveness and can be widely promoted and applied in future teaching processes.

Keywords: Computed Tomography Thinking; Clinical Thinking; Job Competence; Digital Human Virtual Anatomy System.

1. Introduction

Human sectional imaging anatomy is the science of studying organ morphology, structure, and their relationships from different sectional planes. Conventional teaching methods are relatively single, making it difficult for students to learn and resulting in poor teaching effectiveness. The digital human virtual anatomy system provides more possibilities for teaching and solves the problems and shortcomings of traditional teaching [1]. This study explores the role of the digital human virtual anatomy system in cultivating students' thinking in sectional anatomy, clinical thinking, and improving job competency in the teaching of "Human Sectional Imaging Anatomy" course, providing more evidence for future teaching methods and assessment reforms.

2. Materials and Methods

2.1. Application Subjects

124 students from the 2020 class of Medical Imaging major were selected as the research group, and teaching reform was conducted based on the digital human virtual anatomy platform. 113 students from the 2019 class of Medical Imaging major were selected as the control group, and a combination of traditional theory and practice teaching methods was used for teaching.

2.2. Teaching Implementation

2.2.1. Research Group

Based on the digital human virtual anatomy platform, student-centered teaching reform was carried out to cultivate self-learning ability, mainly focusing on teaching methods, teaching content, and assessment methods. (1) Before class: Teaching content was pushed to students in advance through mobile terminals, including the pathways, functions, preparatory knowledge, and micro-lessons in the digital human virtual anatomy system. Students were required to preview the system anatomy, regional anatomy, sectional anatomy, and corresponding imaging images of the designated areas, using sectional anatomy thinking to understand the morphology, location, and adjacent relationships of human structures in both the whole and sectional views. Students were encouraged to take notes on knowledge points they couldn't grasp, refer to relevant materials, and raise questions in class. (2) During class: Students raised the questions encountered during the preview and discussed them in groups. In the central lecture session, students used the rotating, peeling, staining, and other functions of the digital human virtual anatomy system to explain. They were required to connect theory with practice and foundations with clinical applications. Finally, the teacher supplemented and deepened the teaching content based on the students' grasp of the content to achieve teaching objectives. (3) After class: Using the labeling function in the digital human virtual anatomy system, anatomical structure and sectional imaging image filling test questions were prepared in advance. Students were required to identify structures and fill in the names in the system, submit the results of the skill assessment, and receive grades through system evaluation, which can serve as strong support for formative assessment. At the same time, homework and drawing tasks were assigned after the completion of each chapter, and a theoretical knowledge point assessment was conducted at the end of the semester.

2.2.2. Control Group

The control group consisted of teachers, class hours, and teaching content that were identical to the experimental group. The traditional teaching mode was adopted, with the use of PowerPoint slides to present human anatomy and cross-sectional images in the theoretical class, and observation of cross-sectional anatomical specimens in the practical class. After class, corresponding assignments were completed.

2.3. Statistical Analysis

The statistical software SPSS 23.0 was used for data entry and analysis. Quantitative data were represented as ($x \pm s$) and analyzed using t-tests. $P<0.05$ was considered statistically significant.

3. Results

3.1. Comparison of Theoretical Assessment Scores between the Two Groups

The theoretical assessment scores for the experimental group and the control group were (71.77 ± 9.58) and (66.71 ± 14.90) respectively. Upon comparison, the experimental group had higher scores than the control group, and the difference was statistically significant ($p<0.05$).

3.2. Comparison of Practical Assessment Scores between the Two Groups

The practical assessment scores for the experimental group and the control group were (86.16 ± 8.23) and (75.49 ± 11.94) respectively. Comparing the two, the research group significantly outperformed the control group, and the difference was statistically significant ($P<0.01$).

3.3. Comparison of Assignment Completion and Participation Rates between the Two Groups

The research group assigned homework 12 times, with a total of 1402 participants and a participation rate of 94.22%. The excellent rate was 84.41%. In comparison, the control group assigned homework 11 times, with a total of 1125 participants and a participation rate of 90.51%. The excellent rate was 72.00%. There was a significant difference in the completion and participation rates between the two groups, which was statistically significant.

4. Discussion

4.1. The Digital Human Virtual Anatomy System Enhances Students' Interest and Initiative in Learning

Throughout the teaching process, the functions of rotation, dissection, and staining provided by the digital human virtual anatomy system increased student engagement. Students were able to experience a comprehensive observation of anatomical structures, understand the location and adjacent relationships of anatomical structures in the human body more deeply through structure separation, and achieve a student-centered educational approach. This enhanced students' initiative in learning [2].

4.2. The Use of the Digital Human Virtual Anatomy System has Improved Students' Understanding of Theoretical Knowledge and Practical Skills

Research results have shown that students in the experimental group performed significantly better in both theoretical and practical assessments compared to the control group. This indicates that teaching based on the digital human virtual anatomy system can deepen students' understanding of complex anatomical knowledge [3]. The 3D visualization helps students grasp the relationship between the anatomical structures and systems, as well as the local anatomical structures, which enhances their theoretical knowledge and anatomical recognition abilities.

4.3. The Digital Human Virtual Anatomy System Also Fosters Students' Learning Abilities and Problem-Solving Skills

Through teaching methods such as pre-class materials and flipped classrooms, students are encouraged to shift from passive learning to active learning. They are guided to ask questions, analyze problems, and solve them [4], thereby deepening their understanding of knowledge and improving their overall abilities.

4.4. The Digital Human Virtual Anatomy System Trains Students' Thinking Skills in Sectional Anatomy and Clinical Reasoning, Enhancing Their Competency in Their Future Careers

The system provides students with various learning resources, such as modules on systematic anatomy, local anatomy, and imaging anatomy. Students can observe and understand the same anatomical structure from different dimensions, ranging from systems to sections [5]. Through repeated training, students develop their thinking skills in sectional anatomy and clinical reasoning, laying a solid foundation for their future clinical courses and internships.

In conclusion, the teaching reform based on the digital human virtual anatomy system has played a significant role in the teaching process of the "Human Sectional Imaging Anatomy" course. It stimulates students' interest in learning, trains their clinical reasoning skills, and enhances the competency of students majoring in medical imaging. It provides new insights for the teaching reform of this course.

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