The Effects of Computer-Aided Animation Technology in the Teaching of Hematological Medicine

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Abstract. Clinical hematology and hematology are one of the main courses of the Department of Medical Laboratory Science. In experimental teaching, students are required to correctly identify a variety of cells in bone marrow under a microscope, which is one of the most difficult content for students to master. The traditional experimental teaching of cell morphology has brought different degrees of influence on the teaching effect. In order to make it easier, faster and effective for teachers to teach students about cell morphology in the limited teaching time, and to allow students to more intuitively recognize various cells and increase their interest in learning, it is necessary to reform the experimental teaching methods. Computer-aided animation technology is a three-dimensional composition technology that can display things in reality in three-dimensional images. Applying computer-assisted animation technology to the teaching of hematology in medical schools can display cell morphology more vividly. This will help deepen students' understanding of classroom knowledge. Therefore, this study selected clinical undergraduates who were internships in the Department of Hematology as the research objects. 235 students in the experimental group used the 3D animation technology teaching method in computer-assisted animation technology to teach students "Morphological Changes in the Process of Cellular Immune Regulation"; 257 students in the control group used traditional clinical teaching methods. Through questionnaire surveys and personal interviews, understanding the evaluation of students and teachers on this teaching mode, and comparing the teaching effect through theoretical examination and practical skill assessment.

Keywords: Computer Aided Animation Technology; 3D Animation; Hematological Disease Teaching; Computer Aided Teaching
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1 INTRODUCTION

Hematology is a specialized and practical subject with relatively abstract theoretical content, and there are many laboratory examination items that need to be mastered. Clinical hematology test is a comprehensive clinical discipline with disease as the research object and close combination of basic theory and clinical practice, its main content involves hematopoiesis, pathogenic causes and hematological abnormalities caused by hematopoietic tissue, bleeding tendency and thromboembolism [1]. Traditional theoretical teaching methods teachers use blackboard drawing to explain, it is difficult to explain clearly the shape of cells. Most of the wall charts are also drawn by hand, which has the problem of distortion of cell shape. For the cell morphology is diverse and complex, so the traditional theoretical teaching method is simply to teach by drawing on the blackboard, and students feel boring to this kind of teaching content [2]. For the knowledge of hematology is highly professional, the concept is abstract, and it is mostly cross-related with other disciplines, so for the clinical teachers who are both doctors and teachers, how to use the limited internship time to grasp the key points of teaching and maximize the effect of clinical teaching, allow interns to organically combine abstract theoretical knowledge with complex clinical manifestations and laboratory tests, master important knowledge points and diagnosis points of common diseases, and improve students' initiative in learning? All of this problems are need to be solved urgently in the current teaching of hematology. Computer-aided animation technology can directly present various things, phenomena and even actions in the real world in the form of dynamic images without being restricted by time, space, macro and micro. In medical teaching, computer-aided animation technology can change traditional performance techniques. The microscopic world of cell forms that cannot be seen by the naked eye and cannot be photographed by the camera is presented vividly and concisely in front of everyone, making medical education unprecedentedly efficient and perfect. In the teaching of hematology medicine, computer-aided animation technology can be used to simulate the internal details of simulated cells and reproduce the scene [3]. Computer-aided animation technology can predict the future and easy-to-understand characteristics, making boring medical knowledge vivid. Cell morphology test is an important content of hematology test teaching, to let students remember the cell morphology, the students passively listen, it is difficult to arouse the students' resonance and interest, let alone memory. Therefore, this study uses "Morphological Changes in the Process of Cellular Immune Regulation" in the teaching of hematology medicine as the teaching content, and tries to use computer-assisted animation technology teaching methods to teach hematology to students in the undergraduate teaching of hematology. By using computer-assisted animation technology, making courseware, comparing students' learning feedback, and deepening students' understanding of theoretical knowledge. It is hoped that the initiative, autonomy and creativity of students can be fully mobilized. This can also effectively fill the resource library for teaching blood diseases for the majority of frontline teachers.

2 RELATED REVIEWS

2.1 The Necessity of Changing the Medical Teaching Model of Hematology

Medical simulation education can be divided into basic anatomical models, partial functional training models, computer-aided models, virtual training systems, physiological-driven simulation systems, or omni-directional simulation systems according to different technical methods. The most commonly used in medical education is the application of computer 3D digital models and 3D animations. *Lok, B* and others have developed and developed a set of 3D multimedia software for prosthodontics, aiming to improve the efficiency of information communication through a brand-new digital 3D model, so as to solve the actual problems in dental medicine teaching and clinical doctor-patient communication [4]. *O'Neill, R* discussed the role of 3D models and animations in ophthalmology teaching [5]. *Maweni, R. M* and his teams discussed the application of 3D

animation in clinical teaching of trauma and orthopedics [6]. *Nettath, S* proposed to build a three-dimensional model library for medical education, using three-dimensional software to digitally model the shapes commonly used in medical education to provide high-quality teaching resources for medical education [7]. In the teaching of hematology medicine, three-dimensional reconstruction based on cell morphology, combined with other blood test imaging data, creates three-dimensional digital models and three-dimensional animations for diagnosis and treatment of related diseases. This can demonstrate blood cell production, bleeding tendency and thromboembolism, which is very conducive to the communication between teachers and students in clinical teaching. It can be seen that teaching hematology with computer-aided animation technology combined with 3D model animation is an inevitable choice in the era of digital medicine, and it is also a requirement of the current medical teaching environment in country.

2.2 Teaching Characteristics of Blood System Diseases

Compared with diseases of the circulatory system, respiratory system and digestive system, hematological diseases are more abstract, boring, less intuitive, vivid. It is difficult for students to understand and long-term memory is particularly difficult. They are mostly manifested as fever, hemorrhage, anemia, with or without hepatosplenic lymphadenopathy, which brings certain difficulties to the differential diagnosis of students' diseases [8]; In the diagnosis process of hematological diseases, a large amount of test data such as the count and classification of peripheral blood cells, morphological analysis of bone marrow cells (classification of cells in various lines and stages of bone marrow) and biochemical indicators are also required; The knowledge of this subject has been updated and developed rapidly. New technologies such as modern molecular biology (fusion gene detection) and immunology (cellular immune typing) have been used in clinical hematology, especially in the diagnosis and treatment of malignant hematological diseases. The domestic and international guidelines for diagnosis and treatment of hematological diseases (such as the National Comprehensive Cancer Network and the expert consensus on various types of hematological diseases in China) are updated every year, and the teaching content is updated at any time. *Schiekirka-Schwake, S* pointed out that the unique professional characteristics of blood system diseases made students not only need to master enough basic knowledge, but also need to memorize the highly data-based test results, making learning boring and burdensome [9].

2.3 The Advantages of Computer-Aided Animation Technology in the Teaching of Hematological Medicine

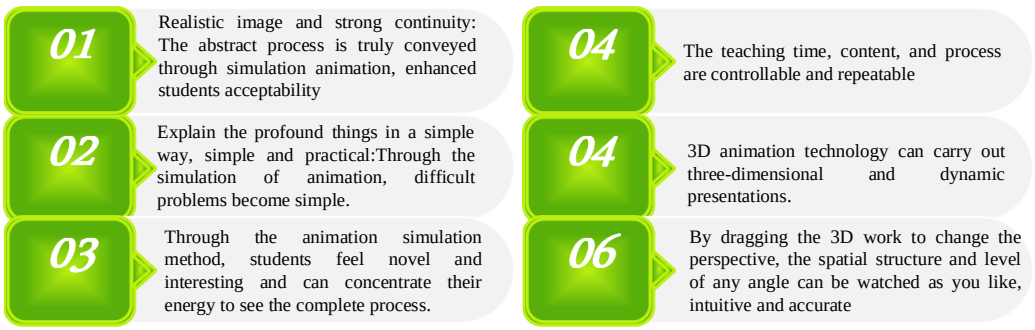

Figure 1: The advantages of computer-aided animation technology in the teaching of hematological medicine.

The traditional teaching method instills the key points of knowledge to the students through the teacher's explanation within the specified time. This kind of teaching method is dull and boring,

and can't stimulate students' enthusiasm for learning. The research results of Oermann, M. H showed that, through computer simulation technology, the typical manifestations and diagnostic methods of blood system diseases were visually displayed to students using three-dimensional images and animations [10]. This can increase the interest of learning, stimulate students' enthusiasm for independent learning, better develop clinical thinking and skills. The advantages of computer-aided animation technology teaching in hematology medicine are shown in Figure 1.

2.4 The Limitations of Computer-Aided Animation Technology in the Teaching of Hematological Medicine

As a useful tool for simulating real objects, computer-aided animation technology is widely used in entertainment, military, medicine, education and many other fields. *Hoyek, N* believed that computer-aided animation technology teaching could visualize and three-dimensional abstract medical knowledge also could mobilized students' desire for learning and knowledge, and promoted their enthusiasm for learning [11]. Teachers should fully understand the importance of computer-assisted technology for clinical teaching, and continuously improve the level of computer theory and software operation capabilities. The teaching and research group of the hematology subject can divide the work and cooperate, give full play to each individual's expertise, and produce courseware that meets the teaching requirements. However, compared with the traditional two-dimensional multimedia courseware, the limitations of computer-aided animation technology in the teaching of hematology medicine are shown in Figure 2.

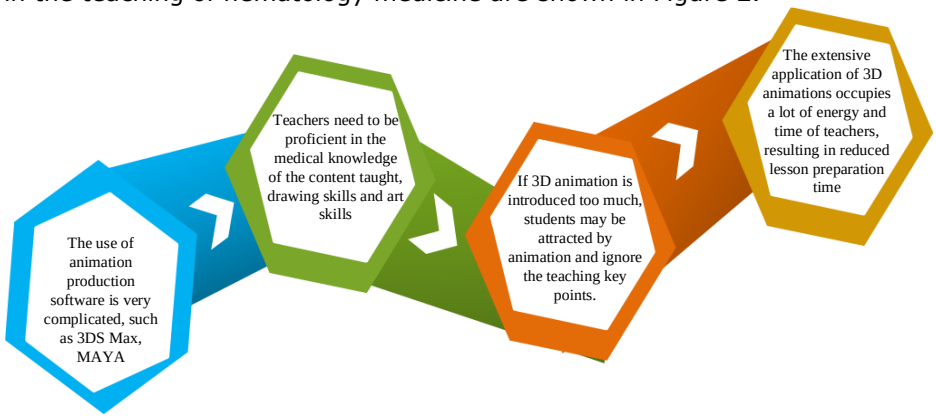

Figure 2: The limitations of computer-aided animation technology in the teaching of hematological medicine.

3 IMPLEMENTATION OF COMPUTER-AIDED ANIMATION TECHNOLOGY IN THE TEACHING OF BLOOD DISEASES

Applying computer-aided animation technology to the teaching of blood diseases, animation technology can change the traditional teaching methods, it can better display the blood cell tissue and other tiny things that cannot be observed by the naked eye. In teaching process, computer 3D animation virtual technology can be used to virtualize cell morphology, found new paths for the diagnosis of blood system diseases. Students can exercise by changing the parameters and observe the internal structure of blood cells in multiple directions, making the teaching more vivid and easy to understand. The domestic animation industry started late. Due to the limitations of technology and equipment, the application of virtual simulation technology in many fields is still blank. In the field of medical education, currently only a single scattered 3D anatomical model can be found, and there is no medical model that forms a complete system [12]. In this study, *Corel Motion Studio 3D software* was used to study the implementation of computer-assisted animation technology in the teaching of blood diseases by taking the changes in the cell morphology of blood

cells in immune regulation in the teaching of blood diseases as an example. The direct and simple design of Corel Motion Studio 3D software allows users to quickly find the tools they need.

3.1 The Making of Teaching Animation Model

This part uses Corel Motor Studio 3D software to describe the production process of a three-dimensional animation model of cell morphology during the immune regulation process of cells (phagocytes, antigens, antibodies, T lymphocytes, plasma cells, and memory cells, etc.).

The specific steps for making phagocyte model are as follows:

(1) Set "Size" to 780*580 pixels, "Background" to white, "Frame interval" to 664 frames, "Light color" to black, and "Ambient light color" to white; (2) Insert "sphere" under "geometric object", and set the parameter "size" to X=160, Y=160, Z=160, "Color" is set to white, the "Position" parameter is set to X=0, Y=0, Z=0, the transparency is set to 50%, and the name is "cell membrane" (as shown in Figure 3a); (3) Select "Sphere" under "Geometric Object", and set the parameter "Size" to X=50, Y=100, Z=50, set the "color" to purple, the "position" parameter to X=-19, Y=-16, Z=0, "arbitrary deformation", name "nucleus"; (4) Group "nucleus" and "cell membrane" into subgroup "phagocyte".

The specific steps of making a 3D plasma cell model are as follows:

(1) Insert "Geometric Object-Sphere", set the "Size" parameter to X = 100, Y = 100, Z = 100, "Color" is set to white, the "Position" parameter is set to X=0, Y=0, Z=0, the transparency is set to 50%, and it is named "cell membrane"; (2) Insert "Geometric Object-Sphere", set the "Size" parameter to X=80, Y=80, Z=80, set the "Color" to pink, and set the "Position" parameter to X=0, Y=0 , Z = 0, named "cell nucleus"; (3) Group "nucleus" and "cell membrane" into subgroup "plasma cells" (as shown in Figure 3b).

By analogy, through the various tools of the Corel Motion Studio 3D software, the process of 3D animation production of other cell models has been completed. Figure 3 shows the effect diagram after the production of various cell 3D animations.

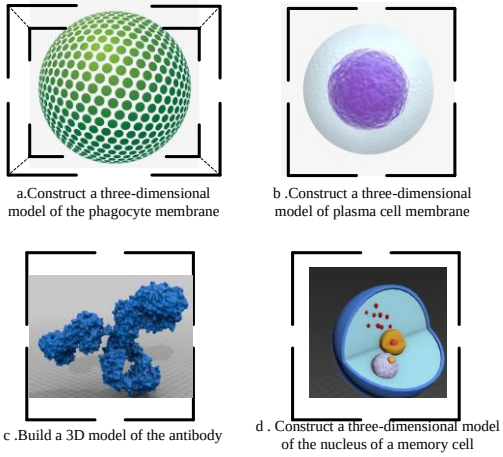

Figure 3: The renderings of various cell 3D animation models during the production process (a: phagocyte membrane; b: plasma cell; c: antibody; d: memory cell).

3.2 The Steps of 3D Animation Production

(1) Hide all objects

(2) "Insert text" --- "antibody", "antigen", "plasma cell", etc. Set "Position" to X=0, Y=0, Z=0; Set "Size" to X=100, Y=100, Z=100; Set "Color" to green; Set the "Transparency" of the first

frame to 100%; Set the "Transparency" of frame 40 to 0; The 85th frame set the "transparency key frame", the 105th frame "transparency" is set to 100%, named "(text)". Following this step to insert other text separately. When all the cells involved in immune regulation are inserted completely, the animation results obtained are partially displayed as shown in Figure 4.

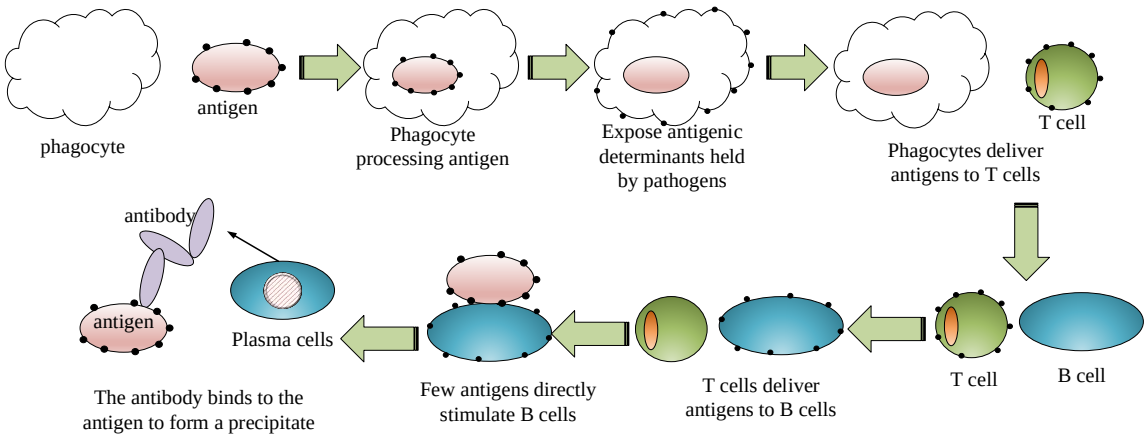

Figure 4: Part of the display process of the animation results of cell morphology changes during the immune process obtained by 3D animation production.

3.3 Animation Generation

Under "File", select "Create Animation File-Export to Mandia Flash (SUT)-Export the designed animation to *swf* format with "JPEG".

The animation obtained by Correll Motion Studio 3D cannot be controlled, the obtained 3D model and animation can be recorded on the screen through Scren Flash software, so that they can be controlled. Specific steps are as follows:

(1) Select "New" under "File" to create a new project, and select "Capture mask area" in the capture mode.

(2) Click on the selection tool, drag it to the area you want to record, minimize the Scren Flash window, and then record;

(3) When the recording is over, delete the unused frames on the time axis;

(4) Select "Play Control Bar" under "Tools", and then select the control bar style;

(5) Select "Output swf" under "File";

3.4 The Animation Courseware is Written by the Teacher of the Inspection Department

The audio-visual staff restructured the multimedia courseware scripts according to the syllabus, and then discussed the manifestation of the courseware with the writers. Simple narratives are expressed in text; try to use flowcharts and tables to summarize, and the more complex flowcharts are explained by animation; If the text is difficult to explain, use pictures as much as possible. If the pictures are difficult to express, use images, vivid animations or videos with simultaneous sound. The computer hard disk is divided into 3 partitions. Disk C is used to install system files and application software, Disk D is used to store courseware materials and make courseware, and Disk E is the backup disk for finished courseware. Create a new "Cellular Immunomorphology" folder on Disk D, in the "Cellular Immune Morphology" folder, create the "Text, Graphics, Icons, Pictures, Videos, Animations, Audio" folders respectively.

4 TEACHING IMPLEMENTATION OF HEMATOLOGY UNDER COMPUTER-AIDED ANIMATION TECHNOLOGY

In order to avoid distractions caused by too long video time during self-study before class, micro-videos are mostly used in teaching classrooms. This study conducted a detailed study of the teaching content and selected its core content. In the morphology teaching of the cellular immune regulation process, we combine PPT demonstrations, 3D animations, voices, etc. to make micro-videos of 10-15 minutes. Provide students with necessary text copies of the video on key content. In order for students to actively participate in the learning of the video and related resources, questions and thinking questions have been added to the video to enhance interaction and focus students' attention on watching the video.

4.1 Objects

This research uses clinical undergraduates who are internships in the Department of Hematology of Gulou Hospital of Nanjing University as the research objects, and the interns have not been exposed to the teaching of computer-assisted animation technology before.

4.2 Research Contents and Methods

The teaching of the students in the control group is carried out by traditional clinical teaching methods, replacing the three-dimensional models and animations with two-dimensional pictures or slides. Two-dimensional pictures can be displayed in textbooks or courseware, and after learning the content of "Immune Regulation" in these 20 classes, exercise tests at the same interval. The experimental group adopts a teaching design using 3D models and animations. The control group did not use the 3D model and its animation instructional design. From the students' exercise test and questionnaire survey after class in "Morphological Changes in the Process of Cellular Immune Regulation"; Teacher’s questionnaire survey, suggestions and opinions are used to evaluate the teaching effect of the three-dimensional model and its animation in the classroom. The students in the experimental group and the control group are taught by the same theoretical teacher and experimental teacher. After the course of "Morphological Changes in the Process of Cellular Immune Regulation", an examination will be conducted on the content of cell morphology. Useing SPSS 22.0 statistical software to perform statistical analysis on student test scores.

4.3 Students' Overall Evaluation of Computer-aided Animation Technology Teaching

This part is based on the students’ absorption and understanding of the knowledge in this chapter, as well as the recognition of the three-dimensional model and its animation, etc. In the teaching process, whether a three-dimensional model and its animation are used to explain the effect of "Morphological Changes in the Process of Cellular Immune Regulation" will be compared and tested. With the aid of the evaluation scale, the learning situation of the students in the control group can be studied: In the class where three-dimensional models and animations are used to explain "Morphological Changes in the Process of Cellular Immune Regulation", Students generally think that the content of immune regulation is not difficult, and they think that it can be mastered by reading it occasionally in their spare time; However, students in the class who did not use the three-dimensional model and its animation to explain "Morphological Changes in the Process of Cellular Immune Regulation" thought this section was difficult. It takes them a lot of time to review after class to reach the level of understanding. The details are shown in Figure 5.

At the same time, the study also used questionnaires to evaluate students' teaching effects on computer-assisted animation technology. Student questionnaire evaluation criteria: the highest score is 10 points, the lowest score is 0 points, the higher the score, the better the teaching effect. The content of the questionnaire mainly includes five aspects: vividness and interest, image authenticity, attention, knowledge acceptance, and learning interest (See Figure 6 for details).

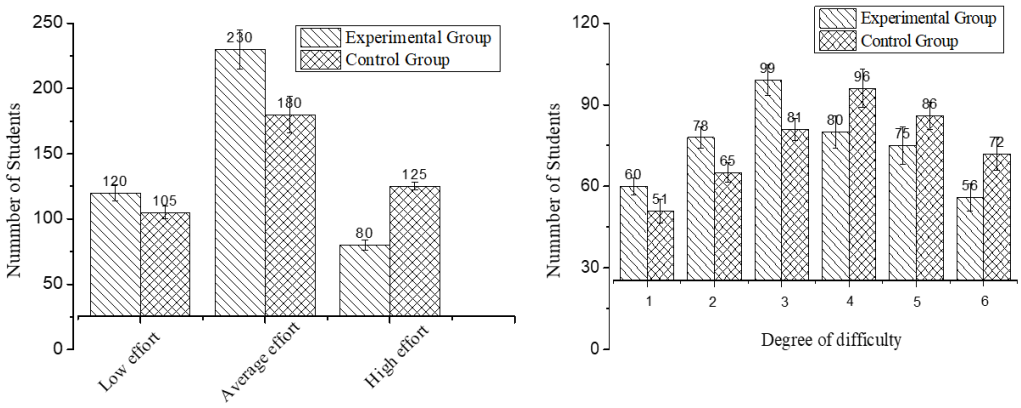

Figure 5: Students' understanding of the difficulty of teaching computer-aided animation technology.

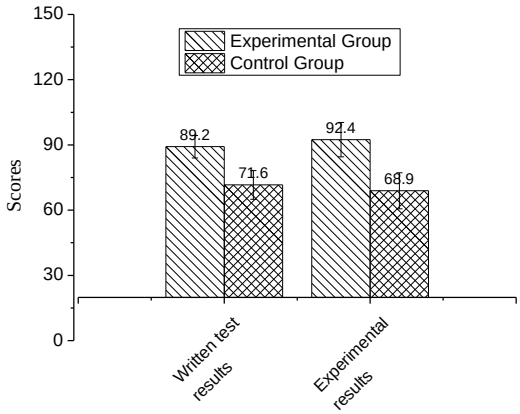

Figure 6: Comparison of teaching effects of teaching modes under computer-aided animation technology.

It can be seen from Figure 6 that the scores of students in the experimental group in the theoretical examination and practical skill assessment are higher than those in the control group, and the difference between the two groups is statistically significant ($P<0.001$). The difference between the two groups was statistically significant ($t=2.597$, $P<0.01$). The experiment group was better than the control group.

In the process of scoring papers, teachers also realized that this group of students' ability to cope with 3D animation technology is also stronger than traditional teaching students. The students in the experimental group answered comprehensively, clearly and accurately. At the same time, compared with the students in the control group, the students in the experimental group have higher scores in terms of vividness and interest, animation authenticity, student attention, acceptance of student knowledge, and student interest in learning. The differences between the two groups were statistically significant, and the experiment group was better than the control group. From this point of view, the auxiliary teaching of 3D animation technology can indeed improve students' ability to analyze and solve problems, and it is worthy of further development in the clinical hematology test course (See Figure 7 for details).

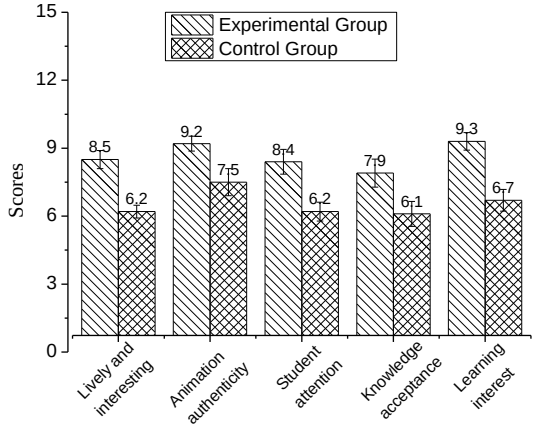

Figure 7: Students' overall evaluation of computer-aided animation technology teaching comparing with two groups.

4.4 Instructor's Feedback on the Teaching of Computer-assisted Animation Technology

Analyzing the questionnaire can draw these results: Although a large part of the teachers surveyed have been exposed to 3D models and animations before, the proportion of 3D models and animations used in the classroom is very small; And in this small percentage of teachers, most of the 3D models and animations used in their classrooms are downloaded from the Internet. These animations have the characteristics of poor picture quality, incomplete teaching content, and simple operation but difficult to control. At the same time, the three-dimensional model and animation designed in the section "Morphological Changes in the Process of Cellular Immune Regulation" in this study are successful; However, there are still some problems in the section of the three-dimensional model and its animation "Morphological Changes in the Process of Cellular Immune Regulation", there are still many defects, and continuous optimization is required. The main problems are as follows: animation screen layout, animation matching corresponding interpretation, animation color matching.

The students also put forward their own views on the promotion of the 3D animation teaching method implemented at this stage and whether there are any shortcomings. Regarding the setting of the number of discussion groups, students believe that if the number of groups can be reduced, it may be more effective to stimulate the enthusiasm of each member. In the current group discussion mode, due to the large number of group members, there are a small number of students who are not serious. They have little or no participation in the preparation of materials after class, and they always enjoy the learning results of other students, Figure 8 showed the details.

5 THE EFFECT OF COMPUTER-AIDED ANIMATION TECHNOLOGY IN THE TEACHING OF HEMATOLOGICAL MEDICINE

In the teaching of hematological diseases, students are stimulated from multiple angles such as audio and video, text, animation, etc., which have a strong attraction and appeal to students, and greatly arouse students' desire for learning and knowledge. It stimulates students' enthusiasm, initiative and creativity in learning, deepens students' understanding of abstract knowledge, and promotes the improvement of students' comprehensive quality. Computer-aided animation

technology puts students in a concrete and realistic three-dimensional reconstruction multimedia environment.

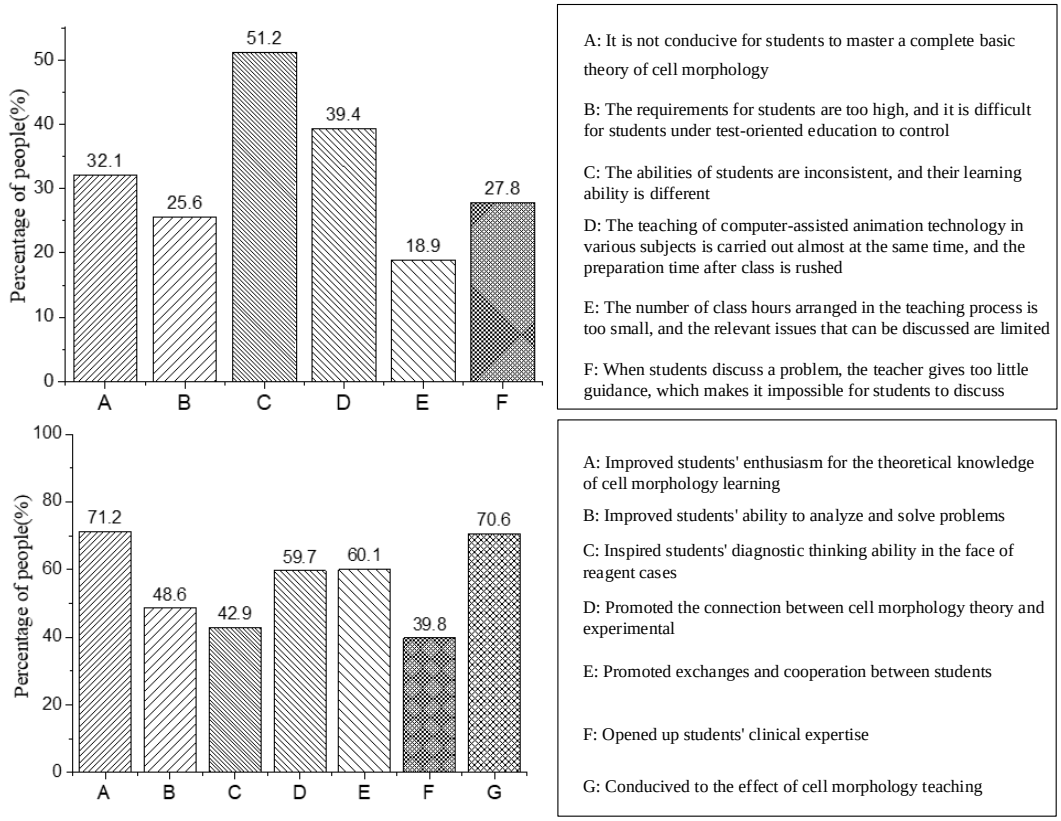

Figure 8: Students' overall evaluation of the course "Morphological Changes in the Process of Cellular Immune Regulation" under the teaching of computer-aided animation technology.

Students explore and understand the teaching content in virtual reality, so as to achieve the purpose of cultivating students' innovative quality and ability in a subtle way [13]. With the development of information technology today, teachers must combine traditional teaching experience with modern science and technology, make full use of the advantages of computer multimedia, and produce good courseware and videos to better improve teaching methods and improve teaching quality. Computer-aided animation technology surpasses ordinary multimedia technology. After the computer-aided animation technology is applied to the teaching system of blood diseases, it can supplement, improve and expand the physical teaching involved in the knowledge field of blood diseases. It can also ensure that the hematology teaching system has good openness and realistic interaction, and promote further changes in orthopedics teaching models and concepts, which will also become an important development direction of the entire teaching reform.

6 CONCLUSION

With the establishment of the modern medical model and the continuous deepening of the reform of the health system, the training methods of medical students are facing new challenges. The clinical practice teaching of medical undergraduates focuses on comprehensive clinical training for students. This is an important part of cultivating medical students' clinical diagnosis and treatment practice ability, consolidating theoretical knowledge and enhancing independent working ability, and also an important part of medical education. The development of hematology is very rapid, but the current teaching methods, methods and methods lag behind the pace of subject development. In recent years, computer-assisted animation teaching has become a new mode of higher education teaching. The construction and sharing of animation teaching is an important part of improving teaching quality and efficiency. This study takes the teaching of "Morphological Changes in the Process of Cellular Immune Regulation" as an example to study 3D animation technology in computer-aided animation technology to produce various immune cells, and to teach animation to students. The research results show that the application of the teaching mode of computer-assisted animation to the teaching of this course can stimulate students' interest in learning blood diseases and make up for the shortcomings of traditional teaching. It can also help students visually see the internal structure of blood cells, thereby improving students' grasp of the structural knowledge of cell morphology, and significantly improving the effectiveness of classroom teaching. In this process, students showed great interest in learning under the guidance of 3D animation. They have enhanced their recognition and memory of cell morphology, and they feel that cell morphology is no longer dull and unpredictable. The teaching quality of teachers has been improved, and at the same time, repeated answers to the same question have been reduced, so that teachers have more time to explain and summarize to the students in combination with specific forms, thereby improving the teaching effect. In view of this, the teachers of hematology subjects should combine 3D animation technology to study new experimental teaching models in the process of carrying out experimental teaching to achieve the teaching purpose of improving the quality and efficiency of hematological medical teaching.

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