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The Application of Virtual Simulated Experiment in the Theoretical Teaching (ABO Blood Grouping) for Physiology

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Abstract

Objective: To explore the effect on students' independent learning capacity through the usage of virtual simulated experiment ((here after referred to as VSE) in the theoretical teaching for Physiology. **Methods:** This research is conducted in Inner Mongolia Medical University. Experimental group: students majored in Forensic Medicine, Class 1, 2019. Self-study teaching mode is applied in the content of blood type and ABO blood grouping with VSE in the theoretical course. Control group: students majored in Psychiatry, Class 1, 2019. Traditional teaching mode is applied to the same content. The effects of these two modes are assessed through test performance and questionnaire. **Results:** Students adopted self-study mode with VSE are superior to those employed traditional teaching mode in test performance. Questionnaires answered by experimental group show that students are satisfied with self-study mode through the application of VSE. Meanwhile, their independent learning capacity has been improved. **Conclusion:** The application of self-study teaching mode with VSE can enhance students' learning effect and contribute to the improvement of self-study ability. It should be applied further in medical theory teaching.

Keywords: Simulated Experiment (VSE); Physiology; Theoretical Teaching, Self-study.

INTRODUCTION

Many prestigious universities, eg. MIT, are equipped with complete professional management standard and information management system in regard to the construction and management of informatization platform in VSE Teaching Center. As early as August 13, 2013 the Higher Education Department of Chinese Ministry of Education issued an instruction to build National-level Virtual Simulated Experiment Teaching Centers across the country. Based on Internet technology platform with the manifestation of simulation by means of virtuality, virtual simulation is a computer system aimed to create and experience the virtual world with the characteristics of interactivity, authenticity and multi-perceptibility [1]. National policy support is provided to the networked VSE technology, with the requirement that VSE teaching should construct highly simulated virtual experiment environment and experimental subject on the basis of modern technology, such as virtual reality, multi-media, human-computer interaction, database and network communication, etc. [2-4].

Followed by the principle — “the combination of virtuality as the top priority and reality as the last option”, domestic medical universities and colleges began to build virtual simulated teaching platform based on Internet technology with the connotation of virtual simulated teaching resources so that teaching and learning can be easily performed [5]. Nowadays a wide range of specialties are involved, including Anatomy, Histoembryology, Functional experiment, Nursing, Physiology, Pathophysiology, Pharmacy and so on. With the integration of VSE system and the experiment & practice of teaching applied in these specialties, in addition to its favorable results, VSE becomes the research focus and growing trend for modern education at home and abroad [6].

The VSE system is gradually put into practice in different specialties from School of Basic Medicine, School of Pharmacy, and School of Mongolian Medicine and Mongolian Medication in Inner Mongolia Medical University. As a functional course and one of the hardest curriculum for teaching and learning in basic medicine, Physiology is dreaded and even disgusted by some students for certain abstract and complicated contents. Characterized by information technology, virtual simulated teaching helps enrich the teaching content and breaks through many limitations caused by traditional teaching methods. Through highly simulated human body environment, questions are visualized clearly for the better understanding of teaching. VSE would play an important role in teaching and scientific research in this new era. Unprecedented advancement would be achieved in the teaching of Physiology and broad

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prospect is expected in its application in medical education^[7]. Meanwhile, it also helps the real shift of teacher's educational concept from "teacher-oriented" to "student-oriented". It can cultivate students' ability to actively analyze, resolve, question and innovate problems. From students' perspective, the change of their idea from "have to learn" to "eager to learn" makes it possible for the self-supervision, self-evaluation and self-improvement in the learning process. Therefore, VSE can be applied in the teaching of physiological theory as an effective means of educational reform.

METHODS

Participants of the research

Experimental group: 40 students majored in Forensic Medicine, Class 1, 2019. Control group: 39 students majored in Psychiatry, Class 1, 2019. Teaching content: the part of blood type and ABO blood grouping excerpted from Chapter III in the theoretical teaching of Physiology.

Self-study teaching mode with VSE is applied to experimental group in comparison of traditional teaching mode conducted by control group. Students in both groups gave their permission for different teaching modes for Physiology. There is no violation to their privacy rights. Students in both groups have taken exactly the same courses since the beginning of their college life till the end of the research. Textbook and teacher for Physiology stay the same during the research.

Teaching practice

ABO blood grouping

Virtual simulated teaching software for ABO blood grouping consists of three parts. The initial part is to learn blood type and get familiar with ABO blood types. The following part is to observe agglutination reaction and identify ABO blood types through experiment. The last part is to test. Teaching objectives, learning procedures and group discussion are posted on the teaching platform. Students can ask questions for uncertain content in the learning process. At the later stage of study, they can conduct literature search in their interested field and have discussion in groups. The whole learning process is followed by the principle — "the combination of virtuality as the top priority and reality as the last option" under the student-oriented circumstance while teacher only playing an auxiliary role in learning.

The design of self-study teaching mode with VSE

Step I: The design for pre-class study

Prior to their learning, tasks for this section, including learning objectives, theoretical knowledge, experimental procedures and various exercises, are listed to serve the purpose that students can generally comprehend the process of self-study in this part, clarify their learning thought, find self-study direction and understand theoretical knowledge with the help of experiment as a supplementary means.

Step II: The design for self-study

(1) Study on platform: the definition of blood type is concisely and explicitly demonstrated with animation by teaching software as the leading-in part before the actual introduction, which allows students to know different antigens inside erythrocyte of Blood Type A, B, AB and O. Instead of the direct indication to point out what kind of antibody is possessed inside serum of these four blood types, agglutination reaction — a sort of antigen-antibody reaction, is manifested when certain change is caused by the combination of antigen and antibody. Erythrocytes are accumulated because of the integration of erythrocytic antigen and its corresponding antibody. Agglutination reaction can be observed by naked eyes with the realization that it should not be exhibited in normal organism for its harmful effect under the situation that blood capillary is blocked by such erythrocytic

accumulation and hemolytic reaction is displayed as a result of erythrocyte rupture generated by the combination of antigen and antibody. Therefore, certain inference is drawn by students that antigen type A can never ever exist in serum of Blood Type A, In the same manner, content in the following section is deduced by students on the basis of their previous knowledge, concluding what kind of antigen is possessed inside erythrocyte of Blood Type A, B, AB and O as well as what kind of antibody is existed inside serum of these four blood types. The awareness for the harmful effect of agglutination reaction helps students make deductive reasoning to think about what kind of principle they should master in blood transfusion, thus knowledge about cross-matching of blood is introduced naturally.



Figure 1: Study on platform

(2) In combination with the textbook: at that time students are suggested to read their textbook as the integration, adsorption and supplementation for this section's theoretical knowledge.

(3) Discussion and feedback: students are advised to participate group discussion which encourage or stimulate them to extend their knowledge for Rh blood type, elaborate arguments on some other special blood types through literature review, expand their scope of knowledge, increase learning interestingness and obtain further understanding for the clinical reliability of cross-matching blood. If their doubt can not be solved through discussion, teachers are available to provide help.

(4) Test: Three questions are designed in the software to reinforce what they have learned.



Figure 2: Question designed in the software

Step III: Post-class assessment

(1) Test performance: At the end of the course, the experimental group and the control group are tested with self-designed papers. A total of 100 points is allocated as follows — choice questions : 10 questions with only one correct choice (5 points for each question), 5 questions with multiple correct choices (6 points for each question). Judgement: 5 True or False questions (4 points for each question)

(2) Questionnaire: Students in experimental group are taken a self-designed questionnaire survey at the end of the course.

Statistical analysis

Software SPSS19.0 is adopted to analyze test performance of experimental group and control group. Scores are expressed as $\bar{X} \pm S$. T test is used to compare the two groups. $P < 0.05$ is considered as significant difference.

RESULT

The comparison of test performance from two groups

The scores of both group are as follows: experimental group (83.6750±9.35452) vs. control group (78.3333±7.79113). It shows clearly that test performance from experimental group is significantly higher than that from control group ($t=2.754, P=0.007$).

Result of questionnaires answered by experimental group

Table 1 is the detailed information of the questionnaire. The results show that students are satisfied with self-study mode through the application of VSE, which is regarded as a useful method to improve their independent learning capacity.

Table 1: Questionnaire for Experimental Group

| Survey Content | Options | Students (Percentage) |
|--|---------|-----------------------|
| Are you familiar with the virtual simulated platform? | Yes | 39 (97.5%) |
| | No | 1 (2.5%) |
| Has learning efficiency been improved by this teaching mode? | Yes | 36 (90%) |
| | No | 4 (10%) |
| Are you satisfied with this virtual simulated software? | Yes | 36 (90%) |
| | No | 4 (10%) |
| What do you think the extent of self-study learning capacity being improved? | Obvious | 36 (90%) |
| | None | 4 (10%) |
| Is your knowledge expanded by this teaching mode? | Yes | 35 (87.5%) |
| | No | 5 (12.5%) |
| Is this teaching mode helpful to master information technology? | Yes | 33 (82.5%) |
| | No | 7 (17.5%) |
| Is group discussion beneficial to your acquisition of knowledge? | Yes | 35 (87.5%) |
| | No | 5 (12.5%) |
| Do you like this teaching mode? | Yes | 36 (90%) |
| | No | 4 (10%) |

DISCUSSION

4.1. The first time to apply virtual simulated project into theoretical teaching as self-study teaching mode with VSE in our university which yields fairly good teaching effect

According to the research findings, 90% of students believe classroom efficiency has been improved and 90% of students are satisfied with their learning effect. It is discovered that the effect of self-study teaching mode is superior to that of traditional teaching mode. Accuracy of timing test by experimental group is significantly higher than that of control group. Students point out in the symposium that it is highly visualized for the application of virtual simulated teaching software in ABO blood grouping, making clear description of the abstract knowledge, giving systematic direction to guide students to think step by step as well as mastering new knowledge in the process of thinking and reasoning.

4.2. The improvement of students' independent learning capacity and the enhancement of their subjective initiative through self-study teaching mode with VSE

The research findings indicate that it is students' first time to conduct self-study with the help of virtual simulated teaching software to learn ABO blood grouping. Statistics show that 90% of students in experimental group think that their independent learning capacity has been improved by this teaching mode; 87.5% of students consider it is beneficial for them to acquire extracurricular literature review; 87.5% of students believe it is quite meaningful to have group discussion with better communication among students and more positive interaction between teacher and student. In the symposium, all of the students express that it is more interesting and easier for them to accept this way of self-study in contrast with their statements that it is extremely boring to read textbooks all by themselves.

CONCLUSION

Nowadays VSE is mainly applied in experimental teaching, but it is rarely used in theoretical teaching. The combination of VSE and theoretical teaching can motivate students to be active learners and guide them to change their learning patterns gradually from passive acceptance to positive absorption of knowledge.

As a classical physiological experiment, ABO blood grouping is the primary means to learn the identification of ABO blood types, observe agglutinative phenomenon in erythrocyte and comprehend the significance of blood type in blood transfusion. However, in recent years this experiment is out of use due to various unexpected dangerous factors in the process of blood collection and the reduction of class hours as a result of functional experimental reform. Nevertheless, as a matter of fact, it plays an important role in the teaching of Physiology. Not only does it help students better understand and master theoretical knowledge, but also it characterizes strong interestingness. Therefore, in conjunction with the requirement to reduce class hours in the experimental and theoretical teaching for Physiology, the experiment of ABO blood grouping is introduced into the teaching process of physiological theory for the purpose that students can master this part of theoretical knowledge more rapidly and actively.

It is discovered in the running process that self-study teaching mode with VSE, on the one hand, can enhance students' subjective initiative, cultivate their independent learning capacity and improve their self-confidence. On the other hand, teaching effect is improved in the following aspects: to achieve the goal of traditional teaching as well as expand scope of knowledge so that students can pay more attention to the frontiers of medical knowledge earlier. Meanwhile class hours for theoretical teaching are saved, which is beneficial to the construction of mixed online-offline teaching mode to meet the need of curriculum reform in Chinese universities.

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