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Comments on Combination of Problem-Based Learning and Immunological Concepts Teaching in Veterinary Immunology Education: A Brief Review

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Abstract: The educational method Problem-Based Learning (PBL) has been spread around the world in medicine and health sciences and proved to be a successful education strategy in many different study domains all over the world. Considering the abstraction and difficult understanding of immunological concepts and theory, combination of PBL and Immunological Concepts Teaching (ICT) has been developed in veterinary immunology education in Northwest A&F University for many years. This review described the curriculum design and effect of this approach in this subject. The teaching approach combined PBL and ICT could effectively deepened understanding of immunological concepts and theories, inspired students' learning interest, expand learners' thinking, cultivated their team and cooperation consciousness and improve ability of knowledge acquisition. This review would have important implication for education of veterinary immunology and other veterinary subjects in this university and other colleges or universities all over the world.

Key words: Problem-based learning, immunological concepts teaching, veterinary immunology education, thinking, China

INTRODUCTION

Veterinary immunology is one of the required subjects and core curriculums for students in veterinary medicine major together with veterinary microbiology, veterinary lemology, veterinary parasite and parasitosis. This curriculum lays particular emphasis on immunodignosis, immunoprophylaxis and immunotherapy which has important implication in prevention and control of animal disease (Rose, 1969; Brunner, 1996; Lunney *et al*., 2002; Entrican *et al*., 2009). And the development and education of veterinary immunology represents the control level of animal disease in one country.

Teaching strategies used to assist learners in learning the fundamental principles and concepts are essential to the education of veterinary immunology. Among many methods used previously in education of medicine, veterinary medicine and other fields (Tavakol *et al*., 2009; Wang *et al*., 2010; Applin *et al*., 2011), the Lecture-Based Learning (LBL) is the most widely used and accepted teaching method in education of veterinary immunology in China. The LBL is a teacher-centered approach and has the noted advantage that could facilitate the learners' ability to master and retain a wide variety of information (Engel, 1991; Sunbald *et al*., 2002; Applin *et al*., 2011). But this technique has been described less effective for learning in medical educations since, it makes learners frequently as a passive information receiving role and does not facilitate cultivation of students' essential skills in practicing professionals such as knowledge application and critical thinking (Kumar, 2003; Applin *et al*., 2011). In 1969, a novel educational strategy, Problem-Based Learning (PBL) was firstly introduced and applied in the domain of medicine at McMaster University (Barrows, 1985).

The PBL is based on the process of working towards the understanding or resolution of a problem which converts teacher-centered to be learner-centered, inspires learners' initiative and learning interest, improves learning efficiency and ultimately promotes lifelong learning (Neville and Norman, 2007; Neville, 2009; Wang *et al*., 2010). At present, PBL teaching has been widely adopted in medical education in Europe, America and Asia. In China, many medical colleges and universities have been using this strategy in whole or in part in educations of medical immunology, medical microbiology, medical ethics and clinical curriculums such as nursing, neurobiology,

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obstetrics and internal medicine (Kwan, 2004; Cohen-Schotanus *et al*., 2008; Wang *et al*., 2010). In education of veterinary medicine although, there are a few reports on PBL teaching (Rivarola and Garcia, 2000; Cox, 2001; Howell *et al*., 2002; Lane, 2008; Schmidt *et al*., 2008), no report in veterinary immunology teaching was found prior to this review. In Northwest A&F University in Northwestern China, the PBL teaching has been successfully used in education of veterinary immunology for many years. Considering the abstract and difficult understanding of immunological concepts and theories, combination of PBL and Immunological Concepts Teaching (ICT) was developed in veterinary immunology education in this university. This review described the curriculum design and effect of this approach in veterinary immunology education with the chapter Antigen as example and main comments on this combination technique in this curriculum education were also discussed.

CURRICULUM DESIGN AND EFFECT OF COMBINATION OF PBL AND ICT IN THE CHAPTER ANTIGEN OF VETERINARY IMMUNOLOGY

A total of 28 students in the same class were divided into four groups with one monitor in each group. The planed time of the chapter Antigen was six credit hours (2 h one time and two times 1 week) with 2 days interval between two times in 1 week. At the first 2 h, the LBL method was used to teach the immunological concepts of antigen and its two characteristics (Immunogenicity and antigenicity) in detail. Then, one question related to clinical case was given to each group, respectively. The question for the 1st group was to explain that animals vaccinated by whole inactivated bacteria could obtain high level antibody against the this bacteria infection but could not get protected by some purified components of the same bacteria. The question for the 2nd group was to tell the possible reasons that animals could not acquire antibody by injecting antibiotics but could obtain antibody by injection of vaccine. The question for the 3rd group was to explain that different levels of antibodies were obtained by different pig vaccinated with the same vaccine. The question for the 4th group was that whether use only one component or whole bacteria to detect antibody level of animal vaccinated with only this component. Students were given 2 days to look up materials and thinking. At the second 2 h, students were organized to discuss and debate within group and among groups and provide new other questions related to these cases. At the third 2 h, the presentation of answers for the questions was given by the monitor or anyone in each group, then teacher evaluated answers group by group and provide real-time analysis and discussion.

The combination of PBL and ICT teaching approach successfully stimulated learners' interest in learning veterinary immunology. Students under this approach deeply understood the contents of antigen, immunogenicity, antigenicity, vaccine, epitope and other related concepts. The process of material reading and problem solving also made students comprehend the immune programs for different animals and grasp the possible causes leading to failure of immune response and factors that affect the immunity to pathogenic agents.

COMMENTS ON COMBINATION OF PBL AND ICT IN VETERINARY IMMUNOLOGY EDUCATION

Understanding of immunological concepts and theories deepened by combination of PBL and ICT: For many students, the veterinary immunology is one of the most difficult curriculums because of abstract contents of concepts. Therefore, the concept teaching appears very important to learners. In the teaching of chapter Antigen, 2 credit hours were spent to detail explain the immunological contents of antigen and its two characteristics (Immunogenicity and antigenicity) which enable students to preliminarily understand of these concepts. To further prehension these concepts, PBL teaching was used. Students could grasp the physico-chemical property of antigen molecules through compared the immunogenicity of whole bacteria and purified components of this pathogen. And the concepts of complete antigen and hapten are easily comprehended by analyzed different immune response to medicine and vaccine. Hence, the application of combination of PBL and ICT in chapter Antigen provides a successful and effective example for veterinary immunology education.

Students' subjective motility and learning autonomy stimulated by PBL: PBL, one effective learning approach with the problem encountered first in the learning processes as well as for the search for the information or knowledge needed to understand the mechanisms responsible for the issue and how it might be (Applin *et al*., 2011). The active cases and questions changed dried and metaphysical traditional teaching mode, promoted students' interest and desire in courses, motivated learners' self-directed learning to find resolution to solve doubts and enhanced lifelong learning behaviors. For example to solve the question to the 4th group that whether use only one component or whole

bacteria to detect antibody level of animal vaccinated with only this component, students' subjective motility and learning autonomy were effectively stimulated by this student-centered teaching mode. Through widely reading materials and discussion with classmates, students not only could get answer to question by themselves but also understand that the specificity of antigenicity is determined by molecular structure of antigen. Therefore, students under PBL teaching are more likely to be good at reasoning and critical thinking, structure knowledge and problem solving using immunological principles in clinical cases.

Thinking mode expanded by combination of PBL and ICT: Commonly, the thinking mode of students in veterinary medicine major is longitudinal and instrumental compared with clinical veterinarians with lateral and integrative mode. The teaching approach combined PBL and ICT promotes students to consult textbooks and related documents or inter-discusses with classmates, the process of which may involve all aspects related to the specified cases and correlate with knowledge in clinic and other subjects. Students under this teaching technology can be facilitated in applying and consolidating learning knowledge and cultivating comprehensive application of skills and lateral thinking. Meantime, this teaching method strengthens the veterinary students' exploring and creative thinking. For the question of 3rd group in the teaching of chapter Antigen that what was the possible reasons for different levels of antibodies obtained by different pig vaccinated with the same vaccine, several students have promoted some interesting questions beyond the curriculum but related to veterinary immunology and some students even use principles of natural immunity and adaptive immunity (These contents should be taught in the following study) to explain this unusual phenomenon.

Team and cooperation consciousness strengthened and ability of knowledge acquisition improved by combination of PBL and ICT: The team and cooperation consciousness are important in practicing professionals (Engel, 1991; Sunbald *et al*., 2002; Applin *et al*., 2011). The teaching approach combined PBL and ICT is based on cooperation of students within and among groups. The ultimately solution of questions are depended on effort and thinking mode of each student which represent the congregate intelligence. In addition to collect all the information related to these cases, students have to look up materials from books, journals, internet and other sources whether published in Chinese or English. These processes trained the students' abilities of oral expression, document consulting, search engine using and English reading and comprehending.

Drawbacks of combination of PBL and ICT in veterinary immunology education: Although, the teaching approach combined PBL and ICT has been presented many advantages in veterinary immunology education, it also has a few drawbacks. This method is not limited in textbooks but has no ready-made teaching materials which would make knowledge system look dispersive and unclear. The small-group and problem-based learning style will need a great number of practiced teachers and much more time spent on the collection of materials for students will decrease learning time on other subjects. Therefore, the solution of these problems would be the main focus in the future study.

CONCLUSION

The combination of PBL and ICT, learner-centered teaching approach could effectively inspired students' learning interest, expand learners' thinking and cultivated their team and cooperation consciousness which has played important role in reform of instruction in veterinary immunology education and is welcomed by students. The further application of this approach in this curriculum and other veterinary subjects has important implication for education of veterinary medicine.

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