Application of multiple methodologies in teaching medical physiology

Accepted 24th April, 2020

ABSTRACT

Medical physiology is a compulsory mainstay course for medical students. As this subject is featured by deep theories and abstract contents, it is generally difficult for the students to understand and grasp. The present study summaries our attempts to use lecture-based learning (LBL) as the main form of teaching activity in combination with problem-based learning (PBL), student lecturing, team discussion and other teaching methods to inspire students' learning interest and cultivate their ability to discover, analyze and solve problems. The results of a questionnaire investigation from the students show that the comprehensive utilization of multiple methodologies in teaching medical physiology has achieved good outcomes.

Key words: Teaching reform, teaching methods.

INTRODUCTION

Medical physiology, as one of the mainstay courses of basic medical sciences, plays an important role in linking the preceding with the following. It is not only the foundation of pathophysiology and pharmacology but has a close link with clinical medicine. However, the course of medical physiology is full of complex contents, abstract concepts and diverse mechanisms, which often intimidate the students. To better stimulate students’ learning motivation and potential, develop and improve their self-study ability and upgrade the teaching quality of medical physiology, we tried using lecture-based learning (LBL) as the base in combination with multiple other teaching methodologies including problem-based learning (PBL) in our teaching activities. The practice has demonstrated that the organic combination of multiple teaching methodologies can, to some extent, enhance the effectiveness of medical physiology teaching.

RESEARCH SUBJECTS AND METHODS

Subjects

Included in this study were 42 Grade 2106 and 2017 medical students for successive bachelor-master-doctoral degrees (BMD), also known as 4+4 medical students, of Shanghai Jiaotong University School of Medicine (Shanghai, China). This BMD class is a traditional distinctive specialty of Shanghai Jiaotong University. All the students in this class are undergraduates who have completed four-year courses in comprehensive universities before entering Shanghai Jiaotong University School of Medicine to major in medicine. After meeting the requirements for graduation and unitive standard of PhD authorization, they will be awarded with the PhD Graduate Certificate and the PhD Professional Degree of Clinical Medicine, and become medical professionals equipped with the solid foundation, high quality and strong capability in clinical medicine.

Teaching methods

The theoretical courses of medical physiology were slated for a total of 72 teaching hours, including 60 h for LBL conducted in a bilingual way. Of the 60 h, 12 h is devoted to PBL, including 4 h for case analysis, 4 h for team-based learning (TBL), and 4 h for student lecturing. The students’ learning performance was evaluated by the percentage,
including 60% for the final examination, and 5% for case analysis, TBL, student lecturing and daily performance each. The final examination was conducted in the written form, and the daily performance was given by the teacher according to the student's performance in fulfilling the after-class assignments.

The complex and diverse contents and abstract concepts such as resting and action potentials and glomerular clearance in medical physiology are difficult for the students to feel and understand intuitively. To better assist the students understand the knowledge frameworks and their intrinsic logic connections in medical physiology, we used a combination of the conventional LBL mode and computed-aided instructions (CAI) to make lectures through figures, tables, videos and cartoons to display the teaching contents intuitively and vividly in front of the students.

Given the training objectives of the PhD medical graduates of Shanghai Jiaotong University School of Medicine, we adopted Chinese-English bilingual teaching in medical physiology using the method of explaining the important and difficult points in Chinese and the supplementary parts in English. To enrich the students with medical professional terms and facilitate their after-class review, the teachers provided the students with the English CAI of medical physiology and introduced to them the English original physiology textbooks as a supplement to bilingual teaching.

To deepen and expand the students' understanding about what they have learned and improve their ability of discovering and solving problems, we applied the PBL-based multiple teaching forms by combing theory with practice on the basis of LBL.

In designing the teaching cases, we emphasized on coherence of the previous and subsequent contents, as well as connections with other related disciplines and clinical medicine using some common daily-life phenomena to arouse the students' attention and learning interest; for instance, changes in arterial blood pressure and skin temperature of football players before and after the match and analysis of the impact of sports on cardiovascular activities; analysis of the impact of altitudes on the respiratory rate and blood oxygen content by giving the example of traveling from shanghai at an altitude of 4 m to Tibet at an altitude of 3650 m and preparations that need to be done before starting the trip. The questions to be discussed were distributed to the students in advance so that they can have enough time to retrieve the literature and solve the problems.

To better cultivate the students' team cooperative spirit, we made some arrangement for TBL in our teaching schedule. Each TBL contained 10 relatively difficult multiple-choice questions for the students to answer on the sport. The students, working in teams with 4-6 students in each team, were required to give the answers in 20 min through discussion. Then, a team was selected randomly to answer these questions, gave reasons for selecting the answers, and received challenges from the other teams. The teacher gave score to the team according to the correct rate of each set of questions and their logic thinking ability in explaining their answers.

Cognization of the fact that LBL cannot fundamentally mobilize students’ enthusiasm and initiative of learning, the teachers designed some questions on some relatively easy and important knowledge points and distributed the questions to the students in advance to raise their self-study ability and stimulate their learning potentiality. The students were grouped with 4-6 students in each group, and each group was responsible for one knowledge point. Such as for the topic of excitation transmission at the neuroskeletal junction, the teacher prepared the following questions for the students: what is the meaning of “ice bucket challenge”? Why is “Antiaris toxicaria Lesch” in the legend life-threatening? With these questions, the students are urged to understand, summarize and sort the new knowledge points through self study and data searching, make multimedia courseware, give lectures in the classroom, and receive questions from the teacher and classmates. A student lecture was usually within 20 min, in addition to 10 min for questions and answers. The teacher gave some guiding instructions according to the questions raised.

### Evaluation of the teaching outcome

After completion of the course, all students were given a questionnaire form about the teaching outcome and required to answer the sheet anonymously. The effective questionnaire response rate was 100%. The questionnaire investigation focused on the impact of bilingual teaching and the PBL-based multiple methodology teaching mode on the teaching outcome of medical physiology.

### Statistical analysis

For the data to be analyzed, it was used the Statistical Package of Social Analysis (SPSS 20). Independent Samples T-test and Univariate ANOVA were used to control the eventual differences among variables.

### RESULTS AND ANALYSIS

**Application of bilingual teaching in LBL**

The result of investigation shows that the students generally accept the bilingual teaching, and about 60% of them hope that the teachers can use 50% of the time to conduct the lecture in English but explain the important and difficult points mainly in Chinese. This request from the
students is basically consistent with the English-Chinese ratio actually used by the teachers. Although 49.6% of the students report that they can basically perceive and comprehend the part taught in English, there are still 36.2% students who report that they can only understand 50%, and there are 14.2% students who cannot understand the teaching content with a poor learning outcome. These results indicate that the English proficiency is not all the same among the students, and therefore pursuing all-English teaching will inevitably weaken the teaching effectiveness. The lack of English professional terms is the number-one factor affecting the teaching efficacy, accounting for 82.4% of the student population. The second factor affecting the bilingual teaching outcome is the absence of corresponding original textbooks of medical physiology written in English and the deficiency in related professional knowledge on the part of the students.

PBL teaching

The students generally welcome the versatile PBL teaching mode. About 74.6% students acknowledge that the cases and questions by simulating the actual situation in PBL can promote them to flexibly make use of the knowledge that they have learned, and improve their ability in analyzing and solving problems. About 60% students hope that the PBL teaching hours can be increased in future medical physiology teaching. With respect to the cases selected in PBL, 62.3% students believe that explanation of some clinical phenomena using simple clinical cases can help raise the students' learning interest, deepen, gasp and use their learned knowledge, and lay a solid foundation for their future academic study and practical work.

In TBL, the students are required to answer the questions on the spot with the given time, and there will be fierce inter- and inter-group discussions. The students generally reflect that although the questions are bit difficult, this kind of teaching activity is more challenging. About 72.8% of students prefer it, thinking that the enthusiastic group discussion can fully mobilize their learning initiative because they can freely express their own opinions, broaden their way of thinking and benefit from collective wisdom during group discussion, all of which can help cultivate their stern and logic thinking ability. In confrontation with questioning from other groups, mutual help within the group members can enhance the team cooperative spirit.

The students feel that their learning interest is stimulated and their self-study ability is improved through the mainstay "self-study and student lecturing" learning mode by keeping the questions raised by the teacher in mind and trying to find the answers in the self-study process of searching, synthesizing and summarizing the knowledge points and making the multimedia courseware. After each student lecture, the teacher will make point-to-point comments on the problems that appear in the lecture so that the students' verbal presentation abilities and skills are improved greatly. About 51.7% students reflect that the “self-study and student lecturing” learning mode is helpful in improving their ability of comprehensive analysis.

DISCUSSION

Selecting an appropriate teaching mode to stimulate students' learning interest

Featured by a systematic lecturing system and complete knowledge points, LBL has long been recognized as a predominant teaching form used in medical student training. In medical physiology teaching, comprehensive and systematic explanation by the teacher can help the students to understand the structure and logic of physiology macroscopically by considering a point in the general context organically, and at the same time help the students to lay a solid foundation in medical science by getting a clear understanding about the connection of physiology with other disciplines and specialties.

Although we have made efforts to make those boring and abstract contents more intuitive, more visual and easier to understand by using large amounts of multimedia courseware, the teachers always play an “actor or actress” role. The “cramming education” form not only deprives the students of thinking independently but the teacher is unable to know how much the students have understood and grasped what he or she has taught. On the other hand, the students who act as the “audience” are passively put in an “input” status, which greatly cripples their learning interest and is quite at odds with the training objectives of developing the students' initiative, improve their self-study ability and stimulate their creative spirit (Dong et al., 2019).

As all medical students in the BMD class of Shanghai Jiaotong University School of Medicine have a solid foundation and strong subjective initiatives, the traditional LBL lecturing form has been far from satisfying the students' strong desire for knowledge and inquiry. In addition, each BMD class only has 15-20 students and such a small-scale class is more appropriate for PBL classroom discussion and other multiple teaching modes. Therefore, on the basis of LBL, we rationally introduce multiple teaching methods including PBL case analysis, student lecturing and TBL to turn the students from the “quest position” to the "host position", making them able to use the knowledge learned in LBL to solve related clinical and living events in the process of data searching, group discussion and presentation, thus greatly stimulating their learning interest and cultivating their logic thinking and analytic abilities. Nevertheless, attention should be paid to the ratio between LBL and other teaching modes in terms of the content and hours, avoiding having the order reversed. Since the students lack a comprehensive
understanding about different specialties and connections between them (much less about clinical medicine), excessive pursuit of form diversity or excessive emphasis on the connection with clinical medicine in the early phase of learning the basic medical sciences can only weaken the basic medical science training of the students, which would interfere with the formation of a complete knowledge system and affect subsequent learning of medical courses, which is unfavorable for the sustainable development of medical professional training.

Through practice, we realize that bilingual teaching should depend on the English proficiency of the students and teaching requirements. Blind pursuit of all-English teaching in all medical specialty courses will inevitably affect the teaching efficacy because it may instill fear and resistance among the students. In addition, professional English can by no means be mastered overnight but needs multiple disciplines to advance together gradually in due order. Only under the premise of ensuring the teaching quality and clearly knowing that the students have mastered the teaching content can bilingual teaching effectively improve the students' professional English level through making high-quality all-English multimedia courseware, importing simplified original textbooks with both pictures and texts, encouraging the students to communicate in English during bilingual teaching, and creating a good linguistic environment.

Upgrading students’ comprehensive quality in an all-round way by rational utilization of the advantages of various teaching modes

With continuous improvement of the training requirements on innovative medical professionals, various teaching modes have been introduced into the classroom, including PBL, TBL, case-based learning (CBL) and research-based learning (RBL) (Ma et al., 2019), and each teaching mode has its own advantages. As long as the teachers have a clear teaching objective in mind, correctly select the teaching methods that are appropriate to the characteristics of the students and their requirements, and organically integrate the respective advantages of these teaching methods, the teaching outcome will be improved with half the effort.

The PBL method has exhibited its excellent effect in inspiring the students to think, analyze and solve problems independently with the knowledge that they have learned by making full use of the questions to guide the learning process through various forms (Kandi and Basireddy, 2018). In the process of physiology teaching, the students learn how to combine theory with practice through simulating the clinical or living milieu and raising questions from the simple cases, which helps lay a solid foundation for the subsequent medical training. Although the students show great interest in clinical case analysis, the clinical cases designed should not be too complicated, the questions raised should not be deviated to etiological and pathogenic discussions to avoid them becoming the clinical diagnosis- and case conference-orientated CBL, because the students are still in the early phase of learning the basic medical sciences (Sapeni and Said, 2020).

In 2002, American Professor Larry Michaelsen pointed out that the TBL teaching mode should lay more emphasis on knowledge acquisition through group work, and using and deepening the understanding about the knowledge that they have learned in the process of solving the problems (Michaelsen et al., 2008). The aim of introducing TBL into our physiology teaching is not only to enable the students to acquire and enhance the knowledge but learn how to communicate with respect and listen to others so as to cultivate their team-work spirit and form a good incentive and competition mechanism through give-and-take cooperation between the group members.

As compared with TBL, “student lecturing” gives more emphasis on role exchange between the teacher and the student for the sake of cultivating the students’ self-study ability and giving full play to the students’ initiative (Rathner and Schier, 2020). “Student lecturing” is a process of acquiring and reconstructing knowledge for the purpose of improving their logic thinking ability, verbal expression ability and presentation-making skills. During this process, the students become the knowledge disseminators and learning leaders, while the teacher plays the role of answering difficult questions and giving the hints as a “student” in the classroom. The teacher will intentionally “create difficulties” to cultivate the students’ adaptability. This “question-and-answer” process can help the students to clarify the core and connection of each knowledge point.

Existing problems

At present, integrated use of multiple teaching methods is still in the exploratory stage in medical physiology teaching and we have noticed some problems in our practice, such as how to coordinate the time distribution between LBL and other teaching methods and how to arrange the PBL teaching content to guarantee the completeness and coherence of the knowledge framework of medical physiology; how to mobilize the initiative of each student during group discussion; and how to establish a more rational academic performance evaluation mechanism to ensure the smooth development of various teaching methods and evaluate the learning ability and achievement of each student in a more impartial and equitable manner.

REFERENCES


