The Application of Sandwich Teaching Method in the Physical Chemistry Course for Pharmaceutical Specialty Students

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Keywords: Sandwich teaching method; pharmaceutical specialty; physical chemistry; application.

Abstract: For pharmacy students, the content of physical chemistry course is complex, abstract and dull, while the traditional classroom teaching is relatively boring and can cause their resistance. Under that situation, the Sandwich teaching method, which focuses on the combination of teachers' explanation and students' self-study, can be applied to the physical chemistry course. In the teaching process, students' learning conditions and cognitive levels are fully considered; their enthusiasm and initiative are stimulated. Meanwhile, great importance is attached to students' emotional needs, cognitive requirements and the ability to solve problems with knowledge.

1. Introduction

Physical chemistry is an important basic discipline for students majoring in pharmacy, pharmaceutical preparation, pharmaceutical engineering and traditional Chinese medicine. It is closely related to the courses of pharmacy, medicinal chemistry and pharmacokinetics, and is very important for students to study follow-up professional courses. This course starts with the relationship between physical phenomena and chemical phenomena, and explores the chemical principles and laws of drugs through physical experimental methods and instruments. The teaching content involves a large number of physical laws, formulas and theorems, which are relatively Abstract and logically structured. Therefore, it requires students' logical thinking and Abstract thinking ability, which makes it difficult in practical teaching.

2. The Concept of Sandwich Teaching Method

The Sandwich teaching method is usually applied in small class teaching. It can be used together with teaching methods such as group discussion, result presentation and cross-learning, so as to promote the communication between teachers and students, give students' main role into full play, mobilize students' initiative and enthusiasm, and cultivate their inquiry spirit, experiment skills, independent learning ability as well as innovation ability. The Sandwich teaching method is widely used in medical teaching. It can change the traditional teaching mode in which teachers talk from beginning to end and students listen passively. The method, like sandwiches which can disperse, mix and re-arrange various nutrients, can combine and integrate different teaching links, and facilitate students' acceptance and absorption of knowledge. [1]

The Sandwich teaching method is a brand-new teaching mode, which was seldom validated and applied in the physical chemistry course before. However, the traditional teaching mode can trigger and intensify students' resistance to Abstract knowledge to a certain extent, so the application of this new, comprehensive and enlightening teaching method is becoming extremely urgent.

3. The Application of Sandwich Teaching Method in the Physical Chemistry Course

The effect of Sandwich teaching method is to break fixed procedures like sandwiches. Through this method, a variety of knowledge can be mixed and blended, so as to promote students' digestion and absorption. Therefore, the corresponding teaching procedure should be planned and designed carefully; teaching activities should be arranged according to the course content.

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3.1 Teachers' lead-in and preparations before class

Firstly, teachers should compile the Sandwich teaching plan before class. The contents include following parts. First, the teacher needs to lead to teaching topics through stories and introductory remarks. Second, the teacher should provide general information and the background of teaching topics. Third, the teacher should clarify learning objectives and tasks, and determine knowledge points needed to be mastered by students in this class. Fourth, 4 or 5 questions should be put forward based on teaching information. Fifth, the teacher needs to summarize the learning effects, and investigate students' abilities to solve problems by virtue of knowledge.

Secondly, teachers need to group and number students according to a certain number. Each group should contain 4-6 people; each student should be numbered correspondingly, such as A-1, A-2, B-3 and C-4.

3.2 Ask questions and answer them independently

At the lead-in part, teachers should make demands on learning contents of this class and students' behaviors.

First of all, lead-in questions should be designed based on the learning content, and closely related to the knowledge of this lesson. The teacher should also take into account students' learning and cognitive levels. Both difficult and easy questions are necessary; all questions should be both inquiry and interesting. Simple questions should be close to the common sense of life and can stimulate students' curiosity and enthusiasm for inquiry. For example, in the part of Carnot Cycle, teachers can set up problems based on the scene of the plug pushed out by steam after heating the tube and the water boils. 1. What happens after the water boils? 2. Where does the power which pushes out the plug come from? According to different types of heat engines in daily life, such as steam engines, internal combustion engines, steam turbines, jet engines, rocket engines and so on, following questions can be set with by help of pictures. 1. Can the efficiency of heat engines reach 1? 2. What is the maximum heat engine efficiency? 3. What are factors related to the efficiency of reversible heat engines? In the chapter of Surface Tension, teachers can ask questions about the concept of the cause of surface tension. For example, according to real life experience, students can be asked to analyze why most of the droplets in real life are spherical, and to describe the relationship between different atmospheric pressures on liquid level and the pressure inside the liquid from the angle of force. These questions are all related to the concepts of physics, chemistry and surface tension that students have mastered. Under the guidance of these questions, students can think deeply and analyze them, so as to mobilize the participation of students in classroom teaching, encourage students to inquiry questions, and help them to further consolidate knowledge they have acquired in the process of thinking and answering questions. [2]

3.3 Group discussion

The independent session should not take a long period of time. Considering the difficulty of questions, some problems cannot be solved independently by students. So after 5 to 10 minutes of thinking and preliminary answers, the teacher needs to ask students to carry out group discussion and summarize their answers.

Every student should actively participate in group discussion. They need not only to express their opinions, but also learn to listen and analyze. Group discussion does not mean simply speak. It requires students to put forward their own views on the premise of equality, democracy and mutual-respect. Members should respect the speeches of other students, clarify their views clearly, and express their own views with clear logic and concise language. After that, members need to summarize their answers under the leadership of the group leader, eliminate unreasonable views, and draw a small conclusion through team cooperation.

Teachers should actively guide and supervise group discussions, and intervene in group discussions appropriately to ensure that every student can actively participate in the activity and control the time. Generally speaking, the session should be completed within 10-15 minutes.

3.4 Cross-group discussion

Group discussion means, students are required to discuss with students inside the group. After the group discussion, the teacher can regroup students according to different rules, and then guide them to carry out group discussion again. All students have formed some views in the previous group discussion, and now their opinions are communicated and collided again. Meanwhile, different students can bring different problems. Cross-group discussion can broaden the scope of discussion, broaden students' horizons of examining problems, and help them to share different viewpoints to form new opinions. This link should be controlled within 20 minutes.

3.5 Outcome representation and teachers' evaluation

Students are re-organized to come back to their original groups according to numbers of A-1, A-2, A-3 and A-4. Each group need to select a representative to summarize the results of group discussion. Speeches can be written in pure language or combined with blackboard writing and the multimedia presentation. Teachers can choose group presentations and reports randomly according to the time needed, and then comment on representative answers. The teacher needs to summarize and evaluate the depth of thinking and knowledge mastering degree of different groups, and analyze the questions correctly.

After the analysis of problems, teachers can put forward deeper problems in combination with what they have learned, so as to test the learning effect of this lesson. For example, in this part of the Carnot Cycle, students should master the calculation formula of the thermal engine efficiency as well as the working principle of thermal memory, and understand the limit value of the thermal engine efficiency. After mastering these contents, the teacher can ask students to think the question, what will happen if the Carnot thermal engine is reversed, and then continue to discuss contents of refrigerator which is closely related to life. In the course of Surface Tension, the teaching objectives include requiring students to master the Kelvin equation and use it to solve problems about the saturated vapor pressure of curved liquid surface. After group discussion and cross-group discussion, students have mastered the concept of surface tension and factors causing surface tension. The teacher can put forward a series of questions according to the relationship between droplet radius and vapor pressure. [3]

4. The Role of Sandwich Teaching Method in the Physical Chemistry Course

4.1 Creating active and harmonious classroom atmosphere

The Sandwich teaching method breaks inherent teaching procedures in the traditional teaching mode. It allows teachers to combine or break links of teachers' guidance and explain, as well as students' self-study and discussion. The fixed teaching procedure is broken to form a solution which combines theory with practice. The links of students' independent learning and teachers' instruction can be integrated and developed alternately. Both teachers and students can express themselves. In the classroom teaching, students can participate in discussions, debates and speeches in various forms and ways. Therefore, the content becomes abundant. The classroom teaching which does not follow the fixed pattern will form a more relaxed, pleasant and active classroom atmosphere. Students do not need to passively listen to the teacher's explanation. Instead, they can actively explore and seek the opportunity to express themselves. To a certain extent, the method can arouse their interest in learning. Students will no longer feel dull and boring about Abstract knowledge.

4.2 Developing students' self- learning ability

In the Sandwich teaching method, the self-study process enables students to think and explore independently after teachers' guidance and questioning. In this process, students' self-study ability is investigated and trained. Only by releasing enough enthusiasm can students play a role in this link, and then show themselves in group and cross-group discussion. This link also allows students to think independently with classmates without the guidance of teachers, which is very important

for the learning of Abstract physical and chemical knowledge. After a period of exercise, students will adapt to this mode of independent thinking and inquiry, generate strong subjective learning desire, and reduce their dependence on teachers.

4.3 Enhancing students' ability to solve practical problems

In the Sandwich teaching method, after the teacher raises questions, students should analyze the essence of the problem through independent thinking, group discussion and cross-discussion to find the solution. At the same time, they should consider the views and opinions of other group members, and form a summary for demonstration. Moreover, they should be able to withstand questions and doubts put by other students when reporting. This kind of learning mode of brainstorming and thinking collision is totally different from the traditional classroom teaching mode. It can bring different thinking experience to students, cultivate their consciousness of solving problems, and enhance their ability of thinking, analyzing and solving problems through long-term exercises. [4]

5. Conclusion

The reasonable application of Sandwich teaching method can make classroom teaching more active, colorful and interesting. It has a very positive role in the teaching and learning of the physical chemistry course which has Abstract knowledge points, complex concepts and a large number of formulas. It can improve the teaching efficiency and quality of the physical chemistry course to a certain extent, and help students to improve their logical thinking ability, problem solving ability as well as team cooperation ability. Of course, teachers should actively and skillfully design classroom activities with the guidance of the Sandwich teaching method, rationally break up and reorganize teaching procedures, guide more students to actively participate in group discussion, arouse students' learning enthusiasm and enhance their degree of participation.

Acknowledgement

This paper is the outcome of the research, Teaching Reform of the Physical Chemistry Course under the Innovative Pharmaceutical Talents Training Model, which is supported by the Foundation for Education and Teaching Reform Projects of Jining Medical University (Project No. 14014).

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