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Investigation on Enhancing Students' Learning Positivity in the Course of Physical Chemistry

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Abstract
Physical chemistry is the main course of chemistry and chemical industry majors, and it is in the connecting position of the curriculum system. According to the characteristics of physical chemistry course, this paper tried to investigate on enhancing students' learning positivity through employing interactive teaching methods, building the overall framework of physical chemistry course, using multimedia to assist in teaching, and connecting theory with experiment and practice. On this basis, inspire students' thinking, develop students' innovation ability, enhance learning positivity, and then improve the quality of teaching.
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Physical chemistry is a science to investigate the basic law of chemical change through physical phenomenon and chemical phenomenon of substance [1]. It plays an important role in inspiring students' thinking, developing students' innovation ability, and improving students' scientific research attainment [2]. Physical chemistry has the characteristics of many formulas and laws, complicated derivation, strong theory, and deep abstraction. It also integrates the subject knowledge of chemistry, physics, and mathematics [3]. Students generally feel that it is a very difficult theoretical course to learn. Interest in learning is low and positivity is not high. According to the characteristics of this course, we try to improve students' learning positivity from the following aspects.

1. Employ interactive teaching methods

The characteristics of this course make students feel boring. Using the routine teaching method is bound to be difficult to improve students' learning positivity, and then it will affect the teaching effect. Appropriate teaching methods can vigorously stimulate students' learning interests and improve students' learning positivity [4,5]. In the actual teaching process, the author implements the student-centered teaching mode, reasonably adopts heuristic, discussion, and other interactive teaching methods. These methods change passive learning to active learning and are propitious to cultivate students' divergent thinking and innovation ability. For example, when we study the adiabatic reversible process of the ideal gas, the students are first asked to recall the mathematical expression of the first law of thermodynamics. On this basis, they are inspired to think about what will happen if $Q=0$ is replaced into the above expression. Combined with the mathematical derivation, an adiabatic reversible process equation of the ideal gas of TV^{r-1}=constant can be obtained. Continue to encourage the students to consider substituting the variable form of the ideal gas state equation ($PV=nRT$) into the TV^{r-1}=constant to acquire two other equations of PV^{r}=constant and $P^{1-r}T^{r}$=constant. Such a gradual teaching process is helpful for students to understand and remember the three important adiabatic reversible process equations. It also activates students' thinking and stimulates students' initiative. Another example is that there are three important formulas of Clausius–Clapeyron equation, van't Hoff equation, and Arrhenius equation in physical chemistry course. They were obtained in the chapters of phase equilibrium, chemical equilibrium, and chemical kinetics, respectively. These three formulas are very similar in form. In the learning process, the heuristic method is used to investigate them and we should guide students to find out the connection and difference between each other, which can significantly reduce the difficulty of teaching and deepen students' understanding of the formula. When learning the state equation of ideal gas and actual gas, the relationship between thermodynamic energy and enthalpy and temperature of ideal gas and actual gas, and Raoul's law and Henry's law, we can also inspire students to compare the knowledge points and find out the similarities and differences between them. The change value calculation of Entropy and Gibbs function is a key and difficult point in chemical thermodynamics. Usually exercises interpretation method is better, but it must pay attention to inspire and guide students to think about what formula to use and how to use it. Let students think independently and put forward their own ideas for solving the problem. If there is a deviation, the students first discuss, and then the teacher prompts, inspires, guides the students into the correct ideas of solving the problem, and deepen understanding. For some hot or difficult issues, teachers can first assign them as the topic of discussion to students, and let students preview and consult the relevant literature. It is necessary to have an open discussion or debate in class and encourage students to express their opinions, make their own views or give personal insights on the views of others. Students must learn with problems and have clear study goals. Through repeated discussion, in-depth thinking, mutual inspiration, and timely feedback, they can gradually understand and master the content learned, change passive learning into active learning, and improve learning positivity.

2. Build the overall framework of the course

Physical chemistry is very logical and systematic, so we can strengthen the construction of overall framework, grasp the internal relation of each chapter, deepen the knowledge connotation, highlight the key points and difficult points, and firmly grasp the basic concepts, basic principles, and basic formulas [6]. It will help to make physical chemistry less difficult and improve students' learning positivity. For example, when learning the introduction section, it is important to summarize the main learning content of physical chemistry course including chemical thermodynamics, solution, phase equilibrium, chemical equilibrium, electrochemical, chemical kinetics, statistical thermodynamics, colloid chemistry, and interface chemistry. On this basis, we should know the research tasks of physical chemistry, clarify the core position of chemical thermodynamics and chemical kinetics in the physical chemistry course, and build the physical chemistry knowledge framework of students. Knowledge must be summarized at the end of each section, each chapter, and the entire course, identifying the internal and mutual connections between them. So that all kinds of knowledge are mastered in a more systematic form. Combined with grasping the key points and difficult points, the messy situation of knowledge is changed. For example, in summarizing the second law of thermodynamics, the core problem of the direction and the limit of spontaneous change is grasped. To obtain the criterion that can solve the above problem, the Entropy, Helmholtz and Gibbs functions are introduced. It is required to master the use conditions of each criterion and to calculate the change value of Entropy, Helmholtz, and Gibbs functions. In the study of chemical equilibrium, electrochemistry, and statistical thermodynamics, it is sure to grasp the three main formulas of $_{\Delta}G=-RT\ln K$, $_{\Delta}G=-zEF$, and $S=k\ln\Omega$. Generally, they are called the bridge formula because they reflect the connection between chemical thermodynamics and chemical equilibrium, electrochemistry, and statistical thermodynamics. They are also the core of each chapter, other content is expanded by this.

3. Use multimedia to assist in teaching

With the development of computer and network technology, the multimedia teaching method has been widely used in the classroom teaching of physics chemistry [7]. Multimedia teaching can make boring content more vivid, intuitive, and interesting. It can also help students to understand the relevant knowledge in a simple way and is conducive to improving the students' learning positivity. Compared with the traditional teaching mode, for teachers, the use of multimedia teaching method is favor of saving time, accelerating the speed of knowledge explanation, improving the efficiency of course teaching, and highlighting the key points and difficult points [8]. It increases teaching capacity and indirectly alleviates the contradiction of more content and fewer class hours. For example, when studying the Bi-Cd alloy phase diagram in phase equilibrium, the temperature-time diagram of pure Bi, pure Cd, and alloy systems with different component is first drawn, and then the corresponding characteristic temperature is found and marked on the T-X diagram. Finally, the points are connected to obtain a simple low co-melting binary phase diagram. Relying on multimedia drawing technology, the detailed change process of the phase in the system can be gradually displayed in the temperature-time diagram, and the whole process of drawing the phase diagram using the thermal analysis method is vividly displayed. Using multimedia to assist in teaching attracts students' attention, activates the classroom atmosphere, and improves students' learning positivity.

4. Connect theory with experiment and practice

In the teaching process, a large number of experiments and practical examples can be employed to enrich and deepen the teaching content of relevant chapters [9,10], so that students can realize the importance and practicability of learning physical chemistry, experience the fun of applying what they have learned, and further mobilize the positivity of learning physical chemistry. For example, when learning electrochemistry, it can be understood in the combination of physical and chemical experiments such as “the determination of dissociation constant of weak electrolyte by conductance method and the determination of potential-pH curve”. In discussing the double liquid system in phase equilibrium, it can be connected with the basic experimental operations in organic chemistry experiments such as recrystallization, distillation, and water vapor distillation. It is feasible to focus on how to apply the phase diagram principle to achieve the separation and purification of components. In the research of interface phenomenon, we need to discuss the Yang-Laplace equation, Kelvin formula, and Gibbs adsorption isotherm. At this time, daily life phenomena such as the water droplets on lotus leaves turning into balls spontaneously, the rise and decline of water and mercury in capillary, artificial rainfall, addition of surfactant during spraying pesticides can be employed as auxiliary explanations. When learning colloid chemistry, it can answer why the sunny sky is blue, the principle of ordering tofu with brine, and why gelatin is added when making ice cream. When the chemical reaction rate is involved, it is discussed how to improve the reaction rate and increase the yield of ammonia combined with the specific situation of industrial ammonia synthesis. This combination of theory, experiment, and practice not only deepens students' understanding of physical and chemical, cultivates the ability to apply theoretical knowledge to solve practical problems, but also expands students' vision, stimulates students' desire to explore knowledge, and is conducive to improving students' learning positivity.

In short, according to the characteristics of physical chemistry, we must change the traditional teacher-centered teaching mode, and give full play to the main role of students. Flexible use of a variety of interactive teaching methods is conducive to keeping students' attention and activing thinking. Furthermore, it is necessary to pay attention to cultivating students' ability of building overall knowledge framework by grasping the internal relation between knowledge. It is also important to use multimedia to assist in teaching and connect theory with experiment and practice to deepen the understanding of the key points and difficult points. On this basis, train the ability to analyze and solve problems, cultivate students' learning interest, enhance learning positivity, and then improve the quality of teaching.

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