Exploration and practice of BOPPPS model in teaching reform of engineering chemistry for materials specialty

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Abstract. Engineering chemistry is the basis of materials science. Students majoring in materials specialty should learn engineering chemistry well and closely link it with materials science. However, it is difficult to achieve the expected teaching effect in the actual teaching process. By analysing the problems existing in the traditional teaching process of engineering chemistry, this study proposes a teaching strategy based on the BOPPPS teaching mode, such as the introduction of the flipped classroom and the classroom Interaction to enhance the interests of students in learning and their self-efficacy, so as to enrich their specialized knowledge and develop their creative thinking and abilities.

1 Introduction

Engineering Chemistry is a required professional basic course for students majoring in materials such as material physics, material chemistry, material science and engineering, material forming and control engineering. The purpose of setting up the course of Engineering Chemistry in the materials specialty is not only to let students be familiar with various materials, such as nano materials, polymer materials, ceramic materials, metal materials, surfactants, etc., but also to make students understand the thermodynamics, kinetics, heat and mass transfer processes involved in the reaction process of materials, be able to regulate the conditions required for reaction, grasp the degree of reaction progress, clarify the reaction mechanism, and establish the reaction models. This course contains many concepts in the theory of chemical reaction, as well as the complicated mathematical formulas, which is widely regarded as one of the difficult subjects to teach, learn and test in university courses. In the teaching process, it is found that students are easily bored with learning, especially in learning with concepts and formula derivation. According to these problems in the learning process and in combination with the characteristics of the Engineering Chemistry course, teachers need to carry out targeted teaching process design and adopt various forms of teaching methods to achieve the all-round interactive teaching

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of teachers and students, so as to provide effective guarantee for the achievement of the curriculum objectives.

BOPPPS teaching model [1,2] is just to achieve the teaching objectives as the core, and ensure the success of the classroom through six elements: bridge-in, objective/outcome, pre-assessment, participatory learning, post-assessment and summary [3]. This teaching model is highly practical and operable to provide a theoretical system in guiding all aspects of classroom teaching for teachers, and make the arrangement of classroom teaching more orderly and reasonable.

2 Traditional teaching model in the course of Engineering Chemistry

The Engineering Chemistry course offered by the materials specialty takes 32 hours to complete, and the corresponding classroom teaching is mainly multi-media based combining with blackboard writing. This course covers thermodynamics, dynamics foundation, electrochemistry, material chemistry, environmental chemistry, energy chemistry, interface chemistry and other chapters, with many complicated knowledge points. The traditional teaching model mainly depends on the detailed explanation of teacher. Students can recognize and understand basic concepts, formulas and theorems through blackboard writing, animation, video and other auxiliary means. Students could be more familiar with key and difficult knowledge through the practical examples, and exercise and strengthen their application skills of relevant knowledge through some exercises after class. However, during the practical teaching process, there are many problems. Most students can't do pre class preview and review after class, which leads to poor effect of classroom questioning, and they lack continuity in understanding and mastery of the subsequent knowledge points. Some students have poor enthusiasm for classroom participation, and sometimes they play with mobile phones, read extracurricular books, doze off, etc. The phenomenon of copying homework is relatively serious, which leads to that the teachers cannot make accurate judgments on the real study situation of students. Considering the above situation, teachers should first start with the design of classroom teaching, take a more reasonable teaching model to replace the traditional teaching method, in order to fully mobilize the learning enthusiasm and subjective initiative of students. In addition, teachers should pay attention to enhance the cooperative spirit and consciousness of students during the classroom teaching, so that the students can learn more knowledge in the limited classroom teaching hours, and have inspiration for their future study and work.

3 Application of BOPPPS model in the course of Engineering Chemistry

3.1 Characteristics of BOPPPS teaching model

The BOPPPS teaching model, originated in the Instructional Skill Workshop (ISW) in British Columbia (Canada, in the 1970s) [4,5], is famous for the effective teaching design, the student-centered concept, and the ideal learning effect [6].

Based on the BOPPPS teaching model, the purpose of "Bridge-in" is to attract students' attention, establish their learning motivation, and stimulate their enthusiasm for learning by introducing the specific problems, relevant examples, video animations, experimental phenomena, etc. Then, teachers should set the specific, observable and evaluable classroom goals, in order to know the students' mastery of the knowledge points after class. Before class, it is necessary to know what the students have mastered about the course and whether

they have wrong ideas or opinions about the relevant content, and then teachers need focus on the course content and adjust the breadth, depth, difficulty and rhythm of the course accordingly. In order to obtain the students' feedback during the pre-assessment process, strategies such as asking open/closed questions, brainstorming, and quizzes can be used, so that teachers should make appropriate adjustments in the course of classroom design and teaching. "Participatory learning" is the core segment of BOPPPS teaching model and the main part of the classroom teaching process. The purpose of in-depth learning can be achieved through the participatory learning in many ways, such as the interaction between students and teachers/students, the fully participation of the students, peer learning, and teachers' guidance, etc. Post-assessment is a stage to understand the students' learning achievements and check whether the present learning goals are achieved. At this stage, short answer questions and multiple-choice questions can be used to test students' understanding of knowledge; students' comprehensive analysis ability of practical problems can be evaluated through teaching cases in order to test students' flexible application skills of learned knowledge. Finally, teachers need to summarize the main points of the lesson, and expand the contents of the course. In the summary stage, the after-class discussion, homework, and the solutions to students' problems and doubts are also essential.

It should be pointed out that BOPPPS is not an isolated model and does not require teachers to teach according to a fixed model. Its significance lies in standardizing the curriculum design and classroom teaching process. It points out that the key link of classroom teaching is participatory learning.

3.2 Implementation of BOPPPS in the course of Engineering Chemistry

Based on the characteristics of the current Engineering Chemistry course, the problems in the traditional teaching process and the basic situation of students, the following measures are mainly taken in the classroom implementation process:

First, BOPPPS teaching model is introduced. During the preparation of multimedia courseware, the setting-up of questions, examples controversial points is to arouse students' interest. Put forward specific measurable learning objectives before each lesson, and test students' learning effects in the following stages. Set up a pre-test to understand the students' prior knowledge of the content of the lesson. Guide students to participate fully in the Engineering Chemistry classroom through improving the teaching methods. Set the post-test stage to grasp the students' mastery of the course content. Finally, summarize and expand the teaching content. The BOPPPS teaching model makes the classroom teaching more orderly and fully mobilize the students' subjective initiative.

The second is to take a variety of forms of participation and mutual learning. The common ways of "Participatory learning" includes group discussion on relevant issues or cases, questionnaire survey, some course relevant topics/events given, reflections on micro-lecture video or other associated short teaching video, online test, etc. All above ways could make students fully participate in classroom teaching, cultivate their teamwork ability and enterprising consciousness, encourage students to actively think about and solve problems, and exercise their language organization and expression ability.

Third, in order to improve the teaching effect, a teaching method of the flipped classroom [7] combining with the BOPPPS teaching model is used. The BOPPPS teaching model can greatly improve the students' participation in the classroom, and the phenomenon of students' attention wandering, nodding off, and playing with mobile phones in the class is significantly reduced. However, some problems are still encountered in the practical implementation process. Most of the students cannot perform the pre-class preparation and review after class, and they do not consult the related textbook or reference materials on their own initiative for the knowledge points they do not understand. As a

result, students cannot establish a complete knowledge framework, and the cohesion between the front and back knowledge points is poor. In the group discussion, due to the insufficient preparation of students, they are short of in-depth thinking and exploring. The online learning model of flipped classroom can greatly improve students' extracurricular learning effect, enable students to understand what they have learned before class, put forward questions, and think about and consult materials in advance, which can significantly improve the teaching effect and efficiency of participatory learning in BOPPPS model. Students can integrate, digest and absorb the knowledge they have learned in time after class, which can enhance the depth of learning and deepen the level of knowledge internalization.

4 Conclusion

In view of the problems in the traditional teaching of Engineering Chemistry, this study proposes a teaching strategy that focuses on BOPPPS teaching model and appropriately combines flipped classroom teaching. For teachers, it can arouse students' interest in learning and clarify teaching objectives. It also could adjust the teaching form according to the study situation of the students, and fully mobilize the enthusiasm of students through participatory mutual learning. Through the post-assessment, students can be reasonably tutored and reviewed after class. The use of flipped classroom can ensure the smooth implementation of the teaching plan and help to improve the effect of the classroom teaching. For students, it can improve their subjective initiative, exercise their independent learning ability, and obtain the self-satisfaction and achievement during the learning process, and ultimately improve the learning effect.

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