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A Preliminary Study on the Reform of Teaching Mode of Polymer Virtual Simulation Experiments

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Abstract: ***The advent of the information age helps to combine new technologies and new concepts with existing teaching models, and the construction of teaching models suitable for students of different ages and majors has become a research hotspot in the field of education and teaching reform. Based on the curriculum characteristics of "polymer material experiment" and the problems existing in the traditional teaching mode, this paper analyzes the advantages and feasibility of the "problem-oriented" teaching method, focuses on the construction of the "problem-oriented" driven polymer virtual simulation experiment teaching model, promotes the integration of experimental teaching and virtual simulation technology, and integrates the new requirements of "new engineering" in the implementation process, and conducts a questionnaire survey and analysis on the practical effect of the teaching mode, and finds that the model can better stimulate the "spontaneous learning" potential of students and enhance it. The synergy of teaching and "learning" ultimately achieves the purpose of improving the teaching effect.***

Keywords: Polymer material experiment; New Engineering; Problem-oriented pedagogy; Virtual simulation; Reform of teaching models.

1. Introduction

Materials are the material basis of all human production and life, and the ability to understand and use materials determines the social form and the quality of people's life. New materials are the cornerstone of the development of strategic emerging industries. The total output value of China's new materials industry was 4.5 trillion yuan in 2019, of which polymer materials accounted for more than a quarter of this growth. "Experiment of Polymer Materials" is a compulsory course for students majoring in materials chemistry. It has the characteristics of operation and practice, which can deepen students' understanding of the concepts and principles of polymer physics and chemistry.

The Ministry of Education has strengthened the macro guidance on the work of experimental teaching informatization, and has continuously issued the spirit and documents such as the 10-year Development Plan for Education Informatization (2011-2020) and the Notice on the Construction of Exemplary Virtual Simulation experimental teaching Projects from 2017 to 2020. It is clear that the experimental teaching project and modern information technology need to be deeply integrated. Therefore, under the background of building new engineering, with the help of the virtual teaching

resources of the virtual experiment center platform of our institute, a "problem-oriented" teaching model is planned to be constructed to practice the application mode of virtual simulation experiment project in the material chemistry major by taking the experimental course of polymer materials as an example. In order to train to meet the needs of economic and social development of compound talents.

2. Problems Existing in Traditional Teaching Mode

2.1 Over-reliance on Precision Instruments

Most of the experiments of "Polymer Materials Experiment" course rely on medium-sized precision instruments and equipment, and some involve large expensive instruments. Due to the small number of expensive instruments and equipment in colleges and universities, polymer experiment courses can only be taught by teachers in the form of narration or demonstration to realize students' sample preparation and instrument operation. Under such circumstances, it is difficult for students to have their own independent experiments and practice opportunities through observation and analysis, and the lack of practical perception and awareness has affected the cultivation of students' hands-on ability, independent analysis and problem-solving ability to a certain extent.

2.2 Limited Setting of Experimental Course Content

"Polymer Material Experiment" is generally matched with "polymer physics" and "Gaofen Chemistry", which covers all the core knowledge points of polymer, but not all the polymer majors in colleges and universities can be equipped with enough related consumables and instruments; At the same time, there will be damage and old phenomena in the use of instruments and equipment, which makes it difficult to systematically and comprehensively develop students' knowledge and skills related to high molecular disciplines.

2.3 Single Teaching Means and Methods

Most of the experimental teaching of polymer materials is mainly through multimedia courseware to assist teachers in teaching, lack of practical problem situation guidance, teaching form is single, and students generally feel boring. At the same time, due to the limited number of class hours, in the case of a large number of analytical technology principles and methods to be taught, there is a lack of effective interaction to promote students' understanding, which makes it difficult for students to digest and understand the learning content.

3. Advantages and Feasibility of "Problem-oriented" Teaching Method

The "problem-oriented" teaching mode caused a lot of attention in China in the early 1990s, from chemistry, medicine, materials to engineering and management. The "problem-oriented" teaching mode is characterized by taking problems as the main line, students as the main body, and stimulating students' initiative in independent learning and exploring problems. It is a kind of education mode centered on students, aiming at improving students' core quality.

3.1 Breaks the Traditional Teaching Model Framework

The "problem-oriented" teaching mode changes the teacher-student relationship in the traditional classroom, focusing on students' independent learning, analyzing problems, finding ways and means to solve problems, and finally completing the whole learning process requires students' independent

participation, from "students to learn" to "students to learn". The whole process reflects the student-centered teaching idea, provides students with a relatively free learning environment, and the role of teachers has changed, becoming the guide for students to complete the task.

3.2 Greatly Stimulate Students' Interest in Learning

The traditional teaching mode generally adopts the teaching method, and the students can not participate in it and gradually lose interest in learning. By setting up a series of realistic scenarios related to the curriculum, teachers take problem-solving as the core driving force, and improve students' professional quality and ability of independent thinking, observation and analysis, and presentation of viewpoints through integrated learning methods of independent learning and group cooperation. Students can experience a sense of satisfaction and success after solving problems through self-initiative exploration, which can stimulate students' enthusiasm and interest in learning.

3.3 Cultivate Students' Independent Learning Ability

Students need to think for themselves about ways and means to solve the problems raised by the teacher. In the process of thinking and solving, it can effectively stimulate students' basic scientific research abilities such as analysis, thinking and summary, thus improving their independent learning ability and laying a theoretical foundation for solving practical problems.

4. Construction of a "Problem-oriented" Driven Polymer Virtual Simulation Experiment Teaching Model

With "problem oriented" as the driving force, the teaching model of polymer virtual imitation of real experience is constructed. The main characteristics of this model can be summarized as follows: taking duty as the main line, students as the main body, and polymer virtual simulation technology as the means. The specific teaching procedure is shown in Figure 1.

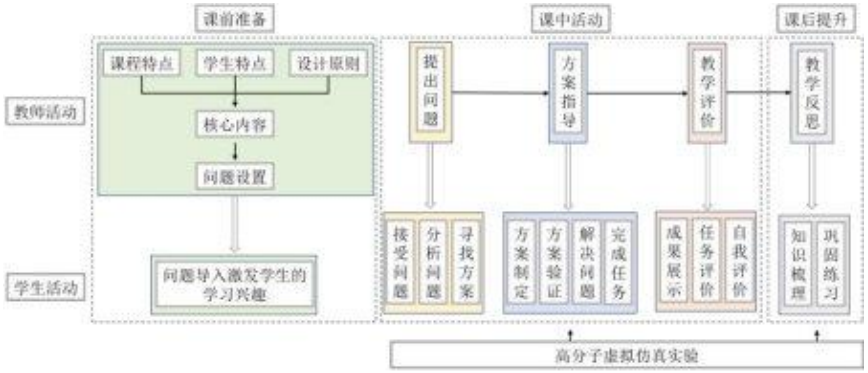

Figure 1: The framework of the "problem-oriented" driven polymer virtual simulation experiment teaching model

In the teaching program, teaching activities are mainly composed of three parts: preparation before class, activity during class and improvement after class, and five modules: question setting, question raising, program guidance, teaching evaluation and teaching reflection.

4.1 Problem Settings

Question setting is mainly the preparation work of teachers before class, and also the key work of teaching activities. The quality of question setting determines the quality of teaching, which should

follow the principles of goal, feasibility, interest and openness. Leave room for students to develop and create, and cultivate students' innovative thinking.

4.2 Asking Questions

After dividing the students into groups, ask the students questions according to the preparation before class. After receiving the problem task, students make use of the existing cognitive system to analyze the problem, and find the solution to the problem through independent learning of new content. The role of teachers has also changed, becoming the guide of students' learning, answering the questions raised by students, and helping students find the key to the problem.

4.3 Solution Guide

After students find a solution to the problem, they use the polymer virtual simulation technology to verify the solution through group discussion and other ways, and continue to improve until the specific solution is given. Teachers mainly help students to develop solutions to problems, and guide and correct the practical activities of students to verify the solutions, so as to ensure that students' problem-solving methods are scientific.

4.4 Teaching Evaluation

After the students complete the task, they use the polymer virtual simulation technology to show their results to classmates and teachers. The evaluation of polymer virtual simulation experiment is completed with various forms of evaluation mode, so as to enrich the effective evaluation of students' learning effect. The scale of student self-assessment, group evaluation and teacher evaluation was used to complete the evaluation. The teacher mainly analyzes and summarizes the problems existing in the completion of tasks and puts forward suggestions for improvement, as shown in Table 1.

Table 1: Student self-rating, group evaluation and teacher evaluation scales

Student personal information			self-evaluation (20%)				
Sequence number	Student number	Family name	Task completion degree (25%)	Degree of participation (25 %)	Degree of mastery of professional skills (25%)	Group cooperation (25 %)	Evaluation score
Student personal information			Group evaluation (40%)				
Sequence number	Student number	Family name	workload (25%)	Degree of participation (25 %)	Application of professional skills (25%)	Group cooperation (25 %)	Evaluation score
Student personal information			Teacher evaluation (40%)				
Sequence number	Student number	Family name	Task completion degree (25%)	innovativeness (25 %)	Professional knowledge and skills (25%)	Group cooperation (25 %)	Evaluation score

4.5 Teaching Reflection

After class, teachers reflect on the activities in class and improve the teaching process. Students should sort out the knowledge points after class, so as to consolidate and understand the key points of the polymer virtual simulation experiment, and improve them through exercises.

5. Analysis of Practical Effects of Problem-oriented Teaching Mode

After a semester of teaching practice, the teaching team used the questionnaire star to conduct a questionnaire survey on the students participating in the polymer virtual simulation experiment, and the survey results are shown in Table 2.

Table 2: The evaluation results of problem-oriented teaching model on improving students' personal ability

Sequence number	Evaluation problem	Very helpful	It helps	No help	Uncertainty
1	The enthusiasm and initiative of individual students in learning	18.2 3%	64.2 9%	0.4 7%	17.0 1%
2	Ability of thinking, analysis and logical reasoning	21.3 1%	64.4 4%	1.0 8%	13.1 7%
3	Innovation consciousness and innovation ability	34.4 6%	56.5 4%	1.8 4%	7.16 %
4	Cooperation and team spirit	72.2 9%	21.9 4%	0.6 4%	5.13 %
5	Communication ability	58.6 7%	18.9 4%	0.5 1%	21.8 8%
6	The ability to synthesize and acquire information	22.3 7%	62.8 5%	0.9 3%	13.8 5%

According to the results of the questionnaire, more than 77% of the students said that the problem-oriented teaching method can improve the students' initiative and activeness in the polymer virtual simulation experiment, and their learning interest is also improved. Students' thinking and analysis ability, logical reasoning ability, innovation ability, teamwork consciousness and communication ability have been improved to some extent; At the same time, it increases students' ability of comprehending and obtaining information comprehensively. The application of this teaching method can play a positive role in classroom teaching.

6. Conclusion

Using the problem-oriented teaching mode, the virtual simulation experiment teaching is applied to the teaching reform of "polymer experiment". After consulting the data and analyzing the basic elements, the teaching flow chart of the model is designed, and the model should be used in teaching practice. Through the analysis of the survey results, it is concluded that the problem-oriented teaching method and virtual simulation integration teaching mode is a good way to stimulate students' learning initiative, can better stimulate students' interest in learning, tap students' potential of independent problem analysis and problem solving, and is conducive to the cultivation of innovative talents in polymer materials science.

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