

Exploration on the Reform of Physical Chemistry Experiment Teaching and Management in Applied College

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Abstract: The teaching system reform about physical chemistry experiment in applied college was discussed in the paper. According to the problems faced by physical chemistry experiment teaching in the process of application transformation in applied colleges, this paper discusses the construction of teaching reform ideas, teaching mode reform, experiment content reform, management system reform, evaluation system reform and reasonable teaching feedback mechanism. Finally, a set of teaching scheme of physical chemistry experimental suitable for applied college is set up, and hope to provide some reference for the reform of the teaching system of the same type of colleges and universities.

1. Introduction

The applied colleges play an important part in exploring the popularization of China's higher education, and their educational objects aim at training applied and interdisciplinary talents. Their professional setting is closely related to social needs. They pay more attention to the application abilities of students in order to satisfy the social needs.

Physical chemistry experiment is one of most important courses in the undergraduate chemical schools [1-2]. But there are some problems in the teaching of physical chemistry experiments. One problem is that the current teaching mode and contents of the physical chemistry experiment courses are not very suitable in applied colleges [3]. The second problem is that the development of new experimental teaching methods and teaching modes is slow and the theory is divorced from practice in the teaching design and learning process [4-5]. In order to solving the problems and improving the teaching quality, the reform of experimental teaching and management was carried out in our school [6], a new teaching and management model of physical chemistry experiment suitable for applied colleges was constructed, which has strong enforceability, sustainability and popularization. This paper describes the exploration on the reform in our school and provides reform case for other colleges.

2. Reform Measures

2.1 Constructing the Reform Framework of Physical Chemistry Experiment Course

The implementation of any reform should have a clear idea, a reasonable top-level design for the existing problems, and the corresponding reasonable and feasible reform measures [7-10]. The teaching group have drawn up the following framework for the reform of experimental teaching and management system, as shown in Figure 1. The framework diagram is developed around the three-level structure of "problems-design-activities". The top-level design (teaching design) is carried out according to the teaching problems, and the reform scheme design (teaching activities) is carried out according to the teaching design.

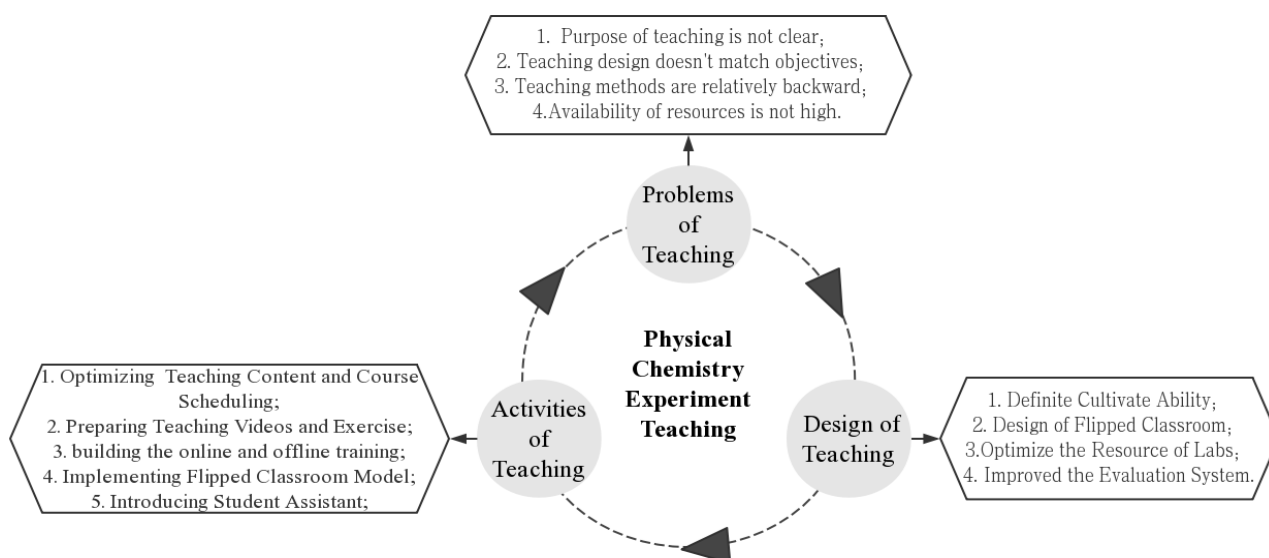


Figure 1. Framework of Physical Chemistry Experiment Teaching and Management Reform

1) Aiming at the problems of unclear teaching purpose and lack of pertinence in teaching activities, the teaching team has a unified understanding that the emphasis of physical chemistry experiment teaching is to cultivate students' practical ability, data analysis ability, and the ability to apply physical chemistry knowledge to solve daily life and production problems.

2) In view of the relatively weak theoretical foundation of students, backward teaching methods and modes, the adequate teaching materials were prepared including teaching videos, exercise library, lecture notes, ppt, besides, two-dimensional code technology and "Rain Classroom" APP were also used to realize the Flipped Classroom.

3) Considering the low resources utilization, the laboratories were optimizing and integrating, and the Course-scheduling semester has been added to ensure that students can choose courses in each semester.

4) The feedback and sustainable mechanism are designed in this structural framework to ensure the rationality of reform. Otherwise, the sustainability and popularization of the reform are considered in the teaching design.

2.2 Reform of the Teaching Mode

The flipped classroom were designed in teaching reform to stimulate students' learning initiative and improve teaching quality. The teaching methods with their own characteristics that meet the requirements of modern education, quality education and innovative education were formed. The teaching process, shown in Fig. 2, including "experiment teaching design → prepared teaching materials → students' self-learning → teaching implementation → collecting evaluation → analysis the feedback".

1) The experiments were choose and analyzed to design the teaching process;

2) The high-quality experimental teaching videos for ~ 200 minutes (including the experimental principle and equipment operation videos for each experiment) were shot and exercise library, lecture notes, ppt were prepared according to the analysis of experimental content. Otherwise, the videos were converted into two-dimensional codes and were printed to post on laboratory for students to prepare for self-study before class and discuss in class. It provided information guarantee for students' free learning, and established a good foundation for the management of the laboratory management;

3) Students are required to clarify the purpose of the experiment, understand the principle of the experiment, master the operation of the experiment, and think about the key points of the experiment before class, at this stage, students were hoped to master 30% of the knowledge;

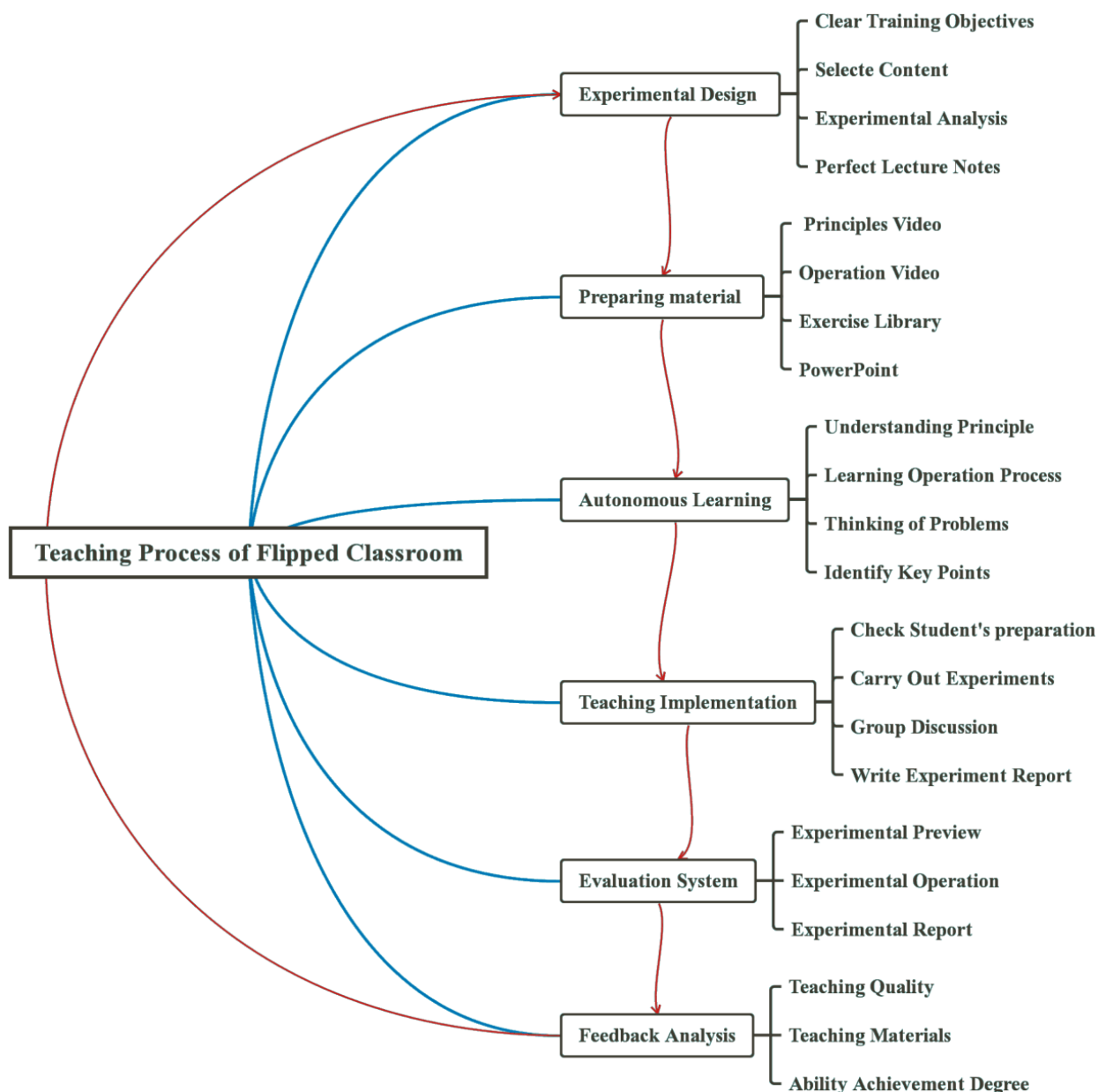


Figure 2. Construction of Flipped Classroom Teaching in Physical Chemistry Experiments

4) When students enter the laboratory, teachers set up some questions to check the students' preview. As the center of the learning process, students deepen their knowledge by completing experiments independently, thinking and discussing problems, and presenting the experimental reports. In the class, teachers changed to be the promoters and instructors of learning instead of being the knowledge imparters in the traditional classroom, at this stage, students have strengthened their knowledge understanding through practical training, which is expected to reach 70% of their knowledge mastery;

5) The students' experiment reports should be feedback in time to help students improve the problems, at this stage, the knowledge was hope to 100% internalized mastery ultimately;

6) The perfect evaluation system was established which paying attention to the whole process from preview to experiment operation to result analysis. And the investigations were carry out about the using of experiment materials, the teaching quality, the rationality of teaching process, etc.

2.3 Reform of Experimental Contents

Combining with the characteristics of applied colleges, we should select or compile suitable textbooks, which should conclude the basic, applied and comprehensive experiments, in addition to routine physical and chemical parameters testing, it is suggested that more applied experiments

related to local economy and the specific requirements of different majors should be set up, which can require students to consult data and design experiments on their own. In addition, the experimental design should be green and non-toxic.

2.4 Reform of Management System

1) Reform of teaching management: limited to experimental equipment sets, multiple groups of experiments usually were setting up at the same time. In the early teaching arrangements, teachers need to spend a lot of time on the on-site explanation of experimental principles and operations. However, the establishment of experimental videos and other teaching resources help students to learn the experiments before class, and teachers give priority to guidance and supervision in class, which provides the possibility for flexible arrangement of teaching space and time. . For example, if a standard laboratory can accommodate four experiments at the same time, it will provides the possibility of adapting to students of the full credit system to choose and arrange courses flexibly, and greatly improves the utilization rate of resources such as laboratories.

2) Personnel management: After the reform, each experienced teacher can teach four experiments at the same time. In addition, high-grade students with excellent results in physical chemistry experiments were employed as assistants. After training, they can assist teachers to prepare experiments, instruct students in class and answer questions after class. It also strengthens senior students' ability to understand and solve problems in experiments. The efficiency of teachers has been greatly improved, and the quality of teaching has also been guaranteed after the reform.

3) Experimental equipment: Regulate safety management of laboratory according to IIEET certification standard. According to the operation of the experiment and the use of instruments, the obsolete equipment were replaced to ensure experimental results. Converting the operating videos of experimental instruments into two-dimensional codes and pasting them on the instruments facilitates students and teachers to engage in teaching and scientific research activities, and improves the instrument training efficiency greatly. Besides, the compensation system for damaged instrument was established to urge students using and maintaining instrument correctly.

2.5 Reform of Evaluation System of Experimental Effect

Establishing a complete, meticulous, fair and accurate assessment system is an important link related to the realization of experimental teaching objectives. It is an important factor in guiding students to study independently and improving the quality of experimental teaching. In order to overcome the disadvantage of mainly depending on the experimental report to judge the student's learning effect, a new evaluation method involving the whole experimental process has been established, to guide students to strengthen their dynamic ability and data analysis ability. The whole process assessment mainly includes experiment preview, experiment operation and experiment summary. Before the beginning of the experiment, the teacher checks the preview situation by various means, and guides the students to think about the key points of the experiment. In the course of the experiment, the teacher pays attention to the standardization of the students' experimental operation and data recording, and their ability to solve problems when they meet with difficulties. After completing the experiment, students are required to complete the experiment cleaning work.

2.6 Reasonable Feedback Mechanism

The rationality of various teaching reform measures needs to be evaluated reasonably. According to the OBE concept, the feedback system of teaching information has been constructed by the teaching group includes students' evaluation of teaching, course analysis table, analysis of the use of teaching video database and students' questionnaire, See Figure 3.

1) First, Students' satisfaction with teachers is evaluated on the network teaching platform, which focuses on teachers' teaching ability, such as whether teachers are conscientious and responsible, whether they prepare lessons adequately, whether they corrected homework conscientiously, whether they are passionate about teaching, etc.

2) The curriculum analysis table analyses the overall situation of students' experiment completion from the perspective of teachers, focusing on the students' ability to achieve in this

course, reflecting on the implementation of the course and giving suggestions for improvement.

3) The analysis of the use of teaching video database is mainly used to evaluate the applicability and existing problems of teaching materials, to determine whether they need to be amended and supplemented, and to analyze students' learning habits and preview situation according to the use data of teaching materials.

4) Student questionnaires involve students' evaluation of the whole teaching process, various teaching reform measures and students' ability attainment. Questionnaires include evaluation of teaching mode, teaching videos, teachers' teaching effect, rationality of achievement evaluation, the use of teaching assistants, etc.

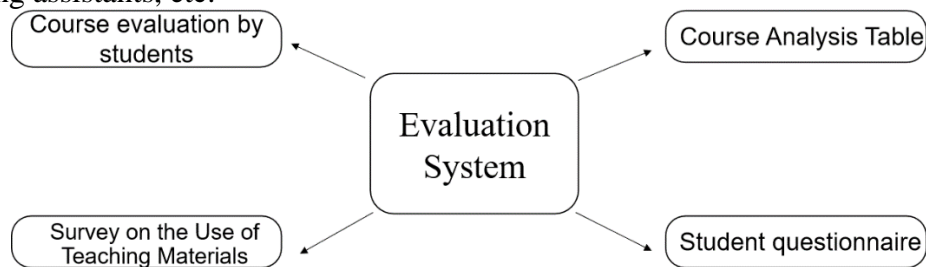


Figure 3. Construction of student evaluation system

3. Conclusion

The improvement of undergraduate teaching quality is a systematic project. The teaching of physical chemistry curriculum system needs to be optimized in all aspects. It needs the close cooperation of university administrators, teachers and students and to explore repeatedly. At the same time, it should follow the trend of development of technology, understand the students' situation, and optimize all aspects of teaching. This paper puts forward that the teaching reform should follow the rational design idea and carry out the targeted teaching reform of the three-level structure of "problem-teaching design-reform plan". Establishing teaching video database resources, realizing "flip classroom", introducing trained senior students as experimental assistants in experimental teaching, paying attention to teaching evaluation and analysis, will help to improve the teaching effect. We hope it will provide ideas and methods for the same type of teaching reform.

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