

Construction of Analytical Chemistry Experiment Network Course

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Abstract—Analytical chemistry experiment course is an important foundation course for the students in chemistry specialty. Traditional lecture-style teaching cannot focus on hands-brain capacity and leave little space for the students to think and create. We propose a network of analytical chemistry experiment course, by setting reasonable experiment content, preparation of systematic, scientific and integrated experimental materials, increasing the synthetically designing experiments to stimulate the students' enthusiasm. The teaching experiment is divided into three different levels, the basic operation experiments, the comprehensive experiments and the synthetically designing experiments. Make full use of the digital teaching platform to realize the diversity of teaching methods. Thus it can enhance the communication and feedback between the students and the teachers, improve the teaching quality of chemical analysis experiment course, and foster the development of innovative high-quality chemical talents.

Keywords—analytical chemistry; experiments; network course; digital teaching platform

I. INTRODUCTION

Analytical chemistry experiment course is an important foundation course for the students in chemistry specialty. The students can develop both rigorous scientific attitude and pragmatic style of work. The students' ability to analyze and solve problems can be practiced with learning the course. Many colleges and universities have committed to optimizing analytical chemistry experiment to improve the overall quality and practical ability to work of the students [1,2]. If traditional lecture-style teaching is used as a single teaching method in education, the students passively follow lectures and teaching materials to complete the experiment, as a result, basic training is difficult to be practiced sufficiently. Such experiments teaching methods make the students develop learning procrastination, therefore the significance of the experiment will not be well understood and the experimental attitudes of the students are not correct. It cannot focus on hands-brain capacity and leave little space for the students to think and create. In response to these conditions, we propose a network of analytical chemistry experiment course, by setting reasonable experiment content, preparation of systematic, scientific and integrated experimental materials, increase the synthetically designing experiments to stimulate the students' enthusiasm. Make full use of the digital teaching platform to realize the diversity of teaching methods. Thus it can enhance the communication and

feedback between the students and the teachers, improve the teaching quality of chemical analysis experiment course, and foster the development of innovative high-quality chemical talents.

II. IMPORTANCE OF CONSTRUCTION

Analytical chemistry course in our school is currently provincial excellent course, but teaching process has some limitations and problems, which restrict the further improvement of the teaching quality of chemical experiment course. Analytical chemistry experiment teaching needs to be improved in these questions.

The course of analytical chemistry experiment teaching using textbooks is issued under Wuhan University's general editorship (the Fifth Edition). The contents of experimental teaching materials for the setting have many different with our experiment teaching syllabus content. For example, the experimental teaching material has two experimental contents that are not involved, namely mixed experimental determination of mixed base in water sample and determination of phosphate content in plant's water sample. In addition, there are four experimental content settings different with the textbook issued under Wuhan University's general editorship. For example, the reference material is not involved in the calibration part of the water hardness measurement experiment. In the experiment of determination of iron content, taking into account the limitations of the experimental class hours and teaching conditions, the teaching process of sample pretreatment using the method are different with the textbook. Because of these problems, the teachers in the arrangement of the experiment become more cumbersome, and even easily lead to misunderstanding of the students.

The analysis of the current chemistry experiment teaching is still mainly to verify the theoretical teaching content. Most of the titration analysis is relatively simple, which cannot stimulate students interest in learning, the students lack of independent thinking space, experiment teaching effect is not ideal. The training of the students' comprehensive ability is difficult to inspire students' creative thinking, and it cannot give conduction to the students in the future to do well in their jobs.

For the main mode of teaching is lecture-style teaching, the students are passively in accordance with the teaching material, resulting in basic training hard to fully carry out. In

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view of the above situation, this project proposes construction of analytical chemistry experiment course network, by setting a reasonable experimental content, writing scientific and systematic teaching materials and increasing the content of the comprehensive experiments. It will stimulate the students' enthusiasm for learning, make full use of the digital teaching platform to achieve the diversity of teaching methods, enhance communication between teachers and students, and improve the analysis quality of chemistry experiment teaching.

III. CONSTRUCTION OF NETWORK COURSE

A. Optimization of the contents

The teaching experiment is divided into three different levels: the basic operation experiments, the comprehensive experiments and the synthetically designing experiments. The basic operation experiments require the students to master the use of laboratory equipment and reagents on the basis of theoretical knowledge, covering the qualitative analytical instrument, the reference material weighing, and the use of indicator. The students should master the basic skills including titration analysis operation, operation of pipettes and measuring flasks, and so on. The students are required to operate properly and gradually achieve proficiency level. Basic skills training to achieve standardized test is the basis of experimental teaching. The comprehensive experiments allow students to learn methods to solve practical problems, and develop the ability to use a variety of experimental techniques[3]. The contents of this section include determination of water hardness, continuous determination of bismuth concentration and lead concentration, and other experimental projects. The synthetically designing experiments are applied to improve innovation ability and initiative of the students. For example, to design an experiment of phosphate determination of water sample, the students are required to design their own programs on the characteristics of phosphate contents of the plant's water samples, complement each other through exchanges between the students, and enable themselves to master the preliminary technology of the designing experiment.

B. Compiling of the network course

Analytical chemistry experiments require the students to use analysis theory and method in practice. The goal is to lay a foundation for the students to learn how to solve practical problems. For the traditional experimental teaching, the teachers tell students experimental subject, theory, instrument, experimental procedures, and even the details and points for attention. This approach is necessary in the analysis of the initial phase of the chemical experiment. The use of the instrument, the basic experimental operation must be carried out in this teaching method. However, a comprehensive experiment requires the students to think, practice and sum up. Our school students mostly work in service sector of power plant water treatment. Based on the fact, for the arrangement of analytical chemistry experimental teaching materials, we delete some obsolete quantitative analysis experiments, increase some comprehensive experiments to improve the students' creative ability and practical ability of design.

Through the comprehensive experiments, the students can master the methods and techniques of the comprehensive analysis experiment, enrich the knowledge and explore the field of vision, and it is a kind of experimental teaching method which is worth promoting.

On the basis of collection of extensive reference materials and related research literature, experimental teaching materials that are chosen should be easy to understand and be in line with the laws of teaching. For optimization of analytical chemistry experiment teaching content, a comprehensive experiment should include repeated experiments and verification experiments, so the content of the experiment is more compact. For the synthetically designing experiment, the teaching task in experiment takes the place of the experiment contexts, and proposes only experimental purposes and requirements. For example, what is the principle method for specific use, what kind of the experimental instruments? The teaching process reflects independent and research-style teaching. The students decide to design the experimental program. The students' ability to learn and capability of innovation for scientific research have been improved.

C. Digital teaching platform

Make full use of digital teaching platform to achieve the diversity of teaching mode[4,5]. Analytical chemistry experiments have many operational links with strict operating standards. Operations and experiments in basic teaching skills are demonstrated in the form of video, and setting on digital teaching platform. The courseware and experimental teaching materials are also placed on digital teaching platform, to achieve teaching resources sharing and enhance communication and feedback between students and teachers.

Strengthen the basic operation training, standardize the experimental operation, and enhance the students' consciousness of standardization. The operation affects the accuracy of the experimental result, therefore the student should achieve the standardization of the basic skill training and proficiency. So from the beginning of the experiment, the teachers emphasize the importance of the accuracy, the habits and other aspects of the basic skills. They also prepare for the accurate assessment of each student's experimental operation, and sometimes discover and correct some students of non canonical and wrong operation, guide the students to seek truth from facts to prepare the experimental records. When the teachers explain the experiment, sometimes let the students on the stage to explain the experimental principle or the experimental procedures, and sometimes the teachers do a wrong operation, and let the students correct. This way of teaching will leave the students a profound impact, and the students are required to operate correctly and achieve proficiency level[6].

As in shown in Fig.1, the main function modules of analytical chemistry network teaching system are electronic lesson plans, teaching video, question answering system and test database, including almost the whole process of teaching analytical chemistry experiment course, and therefore can be aided analytical chemistry experiment teaching and help students to complete the task of learning.

1) The electronic lesson plan covers all the content of the experiment teaching. Electronic lesson plan is equivalent to the reproduction of the content of textbooks, through the choice of the content, the students can learn freely; chemical analysis part includes: introduction, quantitative analytical overview, acid-base titration, complex metric titration method, oxidation reduction titration, weight analysis and precipitation titration, ceiling spectrophotometric method, analysis of chemical data processing, commonly used in the separation, enrichment methods and quantitative analysis of the general steps.

2) Video teaching can vividly display the whole process of teaching. Each experiment has the experiment principle, the experiment operation and the experiment video. Some experiments also have the animation simulation. These can provide a great convenience for students to learn. Analysis of chemical experiment simulation teaching can leave a deep impression to the students than classroom explanation, which has the rich expressive force and good interaction to improve the students' interest, help students to master the key and difficult knowledge.

3) Through question answering system, the students can freely ask the teacher questions, the function module is developed to meet the needs of the students. The students can also post the question on the forum to discuss, avoiding the phenomenon of questions repeated. It facilitate the communication between the teachers and the students, no longer subject to the limitations of time and place. It has played a positive role in promoting the quality of education to guarantee and improve the quality of teaching.

4) Test database are equipped with a variety of questions, are used to detect and consolidate the students' basic knowledge. In the test database, the students can be free to choose exercise. After the submission can be in time to check whether the answer is correct, so that students can easily test their mastery of the content, timely adjustment of their own learning methods and progress. In addition, the test results of teaching and teaching quality can also play a positive role.

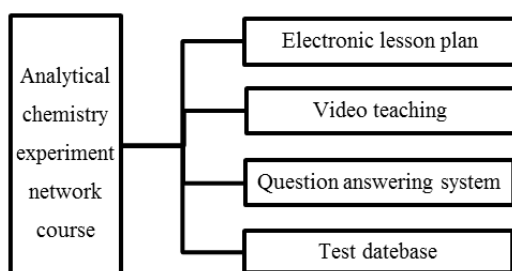


Fig. 1. The main function modules of analytical chemistry network course

IV. COMPREHENSIVE ASSESSMENT OF ACHIEVEMENT

Limited by our school teaching resources, some experiments open in a group of the two persons, so it is easy to make the students have a psychological dependence on their partner. Without their hands-on experiments, it is not conducive to the students' practical ability. The students do not pay enough attention to analysis experiment course, current

experimental appraisal itself has some disadvantages, lack of a scientific performance evaluation method. At the same time, the teachers give the students experimental results, often only pay attention to the accuracy of experimental results and the experimental data. Some factors are considered less, such as the experimental phenomenon, the experimental attitude and experimental operation technology, resulting in the student's actual ability hard to test.

We reform the examination method and give an objective evaluation of the student's experimental results, in order to improve the enthusiasm of students' hands-on experiments. The comprehensive test method is adopted. The test is divided into experimental basic theory of the test, the basic operation of the experimental skills assessment and the completion of the experimental report[7]. The basic theory of the experiment examination uses closed book examination, mainly to examine the students to grasp the basic theoretical knowledge of the experiment, the results of the total score accounts of 40%. Experimental basic operation skills mainly measure the students' ability to master the operation skills and proficiency, as well as the students' experimental attitude in the course of the experiment, which accounts for 40% of the total score. Completion of the experimental report including experimental data analysis and data processing and the completion of a question, the results accounts for 20% of the total score.

Experimental teaching is one of the most effective teaching methods for the implementation of comprehensive chemical education. Through the optimization of teaching content and the reform of performance assessment methods, the experimental course has become an effective way for students to learn and master the scientific methods, so that the students can get comprehensive training. From the implementation effect, the students can carefully observe and think about the phenomenon, consciously find the reason. The learning initiative has been improved and the experimental standardization of operation has been greatly promoted. The experimental report written neatly and clearly with the more profound discussion of the problem, the results of the report are mostly in line with the requirements.

V. CONCLUSION

In order to make students understand the basic ideas of scientific research in the selection of the experiment content, the repeatability and verification of the experiment intersperse in the comprehensive experiment, so that the experimental process is more compact. In the experimental arrangement, the teachers not only pay attention to the typical and systematic experiment, but also pay attention to the combination of inorganic analysis, environmental analysis to increase the practical ability of the students. In the design and application of experimental teaching, the students are encouraged to sum up the literature to design the experiment, analysis and solve the problem. The teachers can realize the diversity of teaching mode based on network teaching resources platform.

By compiling analytical chemistry experiment network course, experimental teaching system of innovation has been achieved. The teaching experiments are divided into three different levels. The basic operation experiments, the

comprehensive experiments and the synthetically designing experiments use different experimental teaching methods. Increase the synthetically designing experiments to realize the innovation of experimental teaching content, improve students' learning interest and scientific research innovation ability. Through the network sharing of the teaching resources of the digital teaching platform, the innovation of teaching mode diversity is realized, and the students' autonomous learning and individual learning are promoted, and the teaching quality is improved.

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