Teaching Status and Teaching Reform Ideas of Physical Chemistry Experiments for Food Quality and Safety Major

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Abstract Physical chemistry experiments are an important branch of chemical experiments. In view of problems and shortcomings in physical chemistry experiment teaching of food quality and safety major in Chengdu University, the teaching methods of physical chemistry experiment course of food quality and safety major were explored and practiced, aiming to arouse students' enthusiasm for experiments and cultivate their ability of independent learning, comprehensive thinking and independent problem solving.

Key words Physical chemistry experiment; Food quality; Safety

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Food quality and safety is one of the focal points of social concern, which needs to be guaranteed in various aspects. Physical chemistry experiments are an important branch of chemical experiments, and serve as an important means to study the basic laws and theories of chemistry through physical chemistry methods. Physical chemistry experiments play a very important role in cultivating students to solve mechanism problems in food safety and food quality change by physical chemistry methods. Based on the analysis of the current situation of physical chemistry experiment teaching in food quality and safety major, this paper discussed existing problems and the application of existing teaching methods and means. On this basis, some ideas and concrete measures of teaching reform were put forward, including updating and optimizing the experimental content, improving the equipment and laboratory conditions, and building a teaching environment with more students' participation and learning atmosphere. These ideas aimed to improve the quality and effect of teaching and lay a solid foundation for cultivating professionals with food safety awareness and practical ability.

Analysis on Present Situation of Physical Chemistry Experiment Teaching in Food Quality and Safety Major

Teaching content

The physical chemistry experiment course of food quality and safety major in College of Food and Bioengineering of Chengdu University has 16 class hours. It is divided into five experiments, namely, the assembly and performance test of thermostatic bath, the determination of combustion heat, the determination of liquid saturated vapor pressure, the preparation and properties of sol, and the determination of sucrose hydrolysis reaction rate constant. The teaching content mainly includes five aspects. The first is basic experimental skills, covering the use of experimental instruments, experimental data collection and analysis methods, *etc.*, which help students get familiar with the basic process and norms of experimental operation. The second is the verification of physical chemistry principles. It aims to verify important principles and laws in physical chemistry through experiments, such as thermodynamic laws and kinetic principles, so as to deepen students' understanding of theoretical knowledge. The third is food-related experiments, involving the application in the field of food quality and safety, such as the determination of sucrose hydrolysis reaction rate constant, *etc.*, with the purpose to cultivate students' ability to apply physical and chemical knowledge to practical problems. The fourth is data processing and analysis, which teaches students how to process and analyze experimental data, including drawing charts, error analysis, *etc.*, to improve students' data analysis ability. The fifth is experimental report writing. Students are required to write detailed experimental reports, including experimental purposes, steps, results and discussions, so as to cultivate their scientific writing ability and scientific thinking.

The main purpose of teaching is to let students get a preliminary understanding of the research methods of physical chemistry, master basic experimental skills of physical chemistry, use some basic instruments and learn important methods for measuring physical and chemical properties, and to make them familiar with a set of rigorous experimental procedures such as observation and recording of physical and chemical experimental phenomena, judgment and selection of experimental conditions, measurement and processing of experimental data and analysis of experimental results. Through experiments, students' knowledge and understanding of physical chemistry principles can be deepened, and their ability to solve practical chemical problems can be improved. Students can be trained in preliminary experimental research, and

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their experimental operation skills can be improved, and their thinking mode of studying food quality by physical chemistry methods can be cultivated.

Analysis of existing problems

Students do not attach enough importance to experiments, and their experimental foundation is weak Since the credit for the physical chemistry experiment course is only 1 point and there is a physical chemistry theory course itself, some students unilaterally believe that the experiment course is only a supplement to the theory course, so their learning enthusiasm is not high and the degree of attention is not enough. In the teaching process, some students often just copy the experimental teaching materials when writing preview reports, without serious thinking and preparation, and especially for the formulas in physical chemistry experiments, they can only copy them mechanically and cannot convert them flexibly. Some students blindly follow the experimental steps or imitate other groups of students in the experiment process, and the experimental efficiency is low. Some students collect experimental data irregularly, record the original data inaccurately, do not take experiments seriously, and even copy other students' experimental data. The above performance shows that students do not pay enough attention to the experimental course, which will lead to poor teaching effect and the condition of failing to achieve the teaching goal of cultivating students' scientific and rigorous scientific literacy and skilled and standardized experimental basic unit operation in the experimental course of physical chemistry[1].

It is a common problem that students have weak experimental foundation. Many students have little contact with physical chemistry experiments in senior high school and lack basic experimental operation skills and theoretical knowledge. It leads to the situation that students face significant difficulties in the experiment and are unable to effectively complete the experimental tasks. Although students have studied the theoretical course of physical chemistry first, due to the difficulty of the course, they still have insufficient knowledge, especially in the transformation and calculation of formulas, and their understanding of the first law of thermodynamics and Reynolds correction is not in place[2].

The use of experimental instruments is not skilled enough. Although students have studied some instruments during their freshman year, they need to use various instruments and equipment in physical chemistry experiments, such as adiabatic oxygen bomb calorimeters, oxygen bombs and polarimeters. However, due to that students lack understanding and practical operation of relevant instruments and equipment in the early stage of course study, and there are a large number of students when the teacher demonstrates the operation of experimental instruments and basic units briefly before the experiment, it can easily lead to some students not being able to see the teacher's operation clearly, resulting in poor teaching effectiveness. There are also some students who don't pay attention to the lecture in the back, and then there are often problems such as improper operation and damage to instruments during the experiment.

The experimental projects are relatively old, and there is not enough connection with food major Although existing experimental contents basically cover the requirements of combining theory with practice, they are relatively old, and some experimental projects have not been updated for ten years. Moreover, the systematicness and connection between projects are poor, and the connection with food major is insufficient, and the depth and breadth related to the actual food processing and safety process are still lacking. The design of some experimental objectives is too simple to cover the requirements for all aspects of physical and chemical experiments in the major of food quality and safety. For example, a large number of formulas are used in the determination of combustion heat, which makes students tired of formula transformation and calculation, and they cannot understand that there is a certain connection between the determination of combustion heat and food autoclaving. At present, the five experimental projects are repetitive and confirmatory, and there is a lack of innovative and comprehensive experimental projects, which cannot well stimulate students to integrate theory with food production practice. The lack of targeted goal setting may lead to the limitations of students in mastering basic experimental skills, which will affect their ability to apply theoretical knowledge to practical operation[3].

Under the background of globalization and the development of market economy, the problem of food quality and safety has become increasingly prominent and has become one of the focuses of social attention. As an indispensable part of human life, the quality and safety of food are directly related to public health and quality of life. The rapid development of modern food analysis technology makes food quality detection more accurate and diversified. The existing physical and chemical experiment projects can't keep up with the development of modern food analysis technology. Most graduates report that the application of the current experimental projects in enterprises or units is not high, and even some students have forgotten relevant experimental courses.

The teaching methods are relatively simple and students' participation is not enough At present, the traditional PPT teaching method combined with demonstration method is adopted in the opening of physical chemistry experiment course. However, some students can't keep up with the rhythm of teaching because of insufficient experimental preparation and the failure to consolidate the basic principles and concepts in time, and they are not clear about what will happen and when will it happen during the experiment. Most students are doing physical chemistry experiments for the first time, and they are not familiar with the experimental process and instruments. In addition, some students don't listen carefully when the teacher demonstrates the operation of experimental instruments and basic units, which leads to a series of problems when conducting experiments independently[4].

In terms of assessment, it is currently composed of four parts, and the usual attendance assessment result accounts for 10% of the total experimental score; the assessment score of

experimental report accounts for 50% of the total experimental score; the assessment result of experimental operation accounts for 10% of the total experimental score; and the final theoretical examination result accounts for 30% of the total experimental score. The assessment of students is still based on the results rather than the process, and the main basis of assessment and scoring is students' experimental report and final theoretical examination, which cannot well reflect the students' standard degree of basic unit operation and their brain and hands-on ability, leading to the condition that some students think that as long as they write a good experimental report and do well in the final exam, it is enough. As a result, students pay more attention to theory than practice, and their participation is not enough.

Tentative Ideas on Teaching Reform of Physical Chemistry Experiments in Food Quality and Safety Major

Update and optimization of experimental content

In the physical chemistry experiment teaching of food quality and safety major, the renewal and optimization of experimental content is the key to improve the teaching quality and students' learning effect. Traditional experimental contents may be outdated or not close to the real application, so it is necessary to update and improve them accordingly. First of all, in view of the latest research and technical progress in the field of food quality and safety, some cutting-edge experimental projects can be introduced. For example, we can explore the research on the physical and chemical characteristics of food packaging materials based on nanotechnology and its impact on food preservation and safety. This kind of experiment can not only stimulate students' interest, but also let them know the practical application of science and technology in food field. Secondly, aiming at common chemical analysis methods in food quality detection, such as high performance liquid chromatography (HPLC) and mass spectrometry (MS), we can design related simulation experiments or small-scale experimental projects. Through these experiments, students can learn specific operation steps and data processing methods of analytical techniques and cultivate their experimental operation ability and scientific thinking ability[5].

In addition, considering the increasing importance of food quality and safety in the context of globalization, interdisciplinary experimental projects can be introduced, such as the interaction experiment between food and environmental pollutants. This kind of experiment can combine the knowledge of chemistry, environmental science and food science, broaden students' academic horizons and enhance their comprehensive problem-solving ability.

In the optimization of experimental content, we should also pay attention to the practical operability and safety of experiments. For example, we can optimize the experimental operation steps, simplify the experimental process, and ensure that every student can participate effectively and operate safely. Meanwhile, the laboratory equipment and instruments should be updated to ensure their matching with the latest scientific and technological development and teaching needs, and the teaching effect and practicability of experiments are improved.

Improvement of equipment and laboratory conditions

In the physical chemistry experiment teaching of food quality and safety major, the improvement of equipment and laboratory conditions is one of the key factors to ensure the experimental teaching quality and students' learning experience. At present, the experimental equipment and laboratory conditions in universities have been able to support the basic teaching needs to a certain extent, but there are still some aspects that need to be improved and perfected.

First of all, the updating of equipment is one of the important ways to improve the experimental teaching effect. At this stage, some experimental equipment may have been used for a long time, and its technical performance is no longer at the leading level, which cannot meet the emerging experimental needs or efficient data acquisition requirements. Therefore, it is necessary to introduce advanced experimental equipment, such as high-precision analytical instruments and data acquisition systems, to improve the accuracy of experimental data and the convenience of experimental operation.

Secondly, the improvement of laboratory conditions is also one of the important work contents. A good laboratory environment can not only improve students' learning enthusiasm, but also effectively reduce the errors and the possibility of accidents in experimental operation. Improving laboratory conditions includes, but is not limited to, the optimization of air quality, the renewal of experimental tables and the improvement of safety facilities.

Furthermore, the management and maintenance of laboratories is also the key to improve the conditions. It is necessary to establish a scientific equipment maintenance system and a laboratory safety management system, and regularly overhaul and maintain experimental equipment to ensure its long-term stable operation and performance optimization. Meanwhile, we should cultivate the professional ability of laboratory managers and technical support teams, and improve their sensitivity and adaptability to equipment operation and safety management, so as to cope with various emergencies and problems.

Student's participation in the construction of learning atmosphere

Through effective participation and active learning atmosphere, students can better understand experimental principles, master experimental operation skills, and enhance the analytical ability and innovative thinking needed in experiments.

First of all, in order to enhance students' participation, we can adopt diversified teaching methods and experimental design. For example, case analysis, group cooperation experiments or simulation experiments can be introduced to stimulate students' interest and exploration spirit by let them participate in experimental design, data collection and result analysis. It can not only enhance

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their experimental operation ability, but also promote the cultivation of teamwork and communication skills.

Meanwhile, it is very important to create a positive academic discussion atmosphere and a good interactive atmosphere in the experimental classroom. Teachers can encourage students to ask questions, share their experimental experience or organize the demonstration of experimental results to promote the communication between students and the sharing of learning results. Meanwhile, establishing a regular feedback mechanism to listen to students' opinions and suggestions on teaching content and experimental process is helpful to adjusting teaching strategies in time and improving teaching effect and learning experience.

Conclusions

According to the actual needs of food quality and safety courses and the relevance of course knowledge and the development of modern food science and technology, experimental schemes can be adjusted in time, so that students can better integrate their knowledge and cultivate their innovative consciousness. We look forward to further improving the quality of physical chemistry experiment teaching of food quality and safety major through continuous teaching reform and practical exploration. It is necessary to strengthen the forefront and practicality of experimental contents continuously and closely combine with the development trend of the industry and scientific and technological innovation, so as to ensure the close connection between teaching content and practical application. Meanwhile, we should continue to optimize teaching methods and means, and introduce more interactive teaching and personalized learning techniques to meet the learning needs and academic interests of different students.

In a word, through the efforts of teaching reform, we believe that the physical chemistry experiment teaching of food quality and safety major will usher in a broader development space and make positive contributions to cultivating more high-quality and professional talents.

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