

Teaching Reform and Practice of Basic Chemistry Experiment Course in Colleges and Universities under the Background of New Engineering

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Keywords: New engineering; Chemical experiment course; Reform in education

Abstract: With the rapid development of chemical industry and the concept of "new engineering", higher requirements are put forward for colleges and universities to train new engineering talents. Chemical experiment is an important means for students to deepen their theoretical knowledge and improve their innovative consciousness, and it shoulders an important mission for cultivating outstanding chemical talents. However, the shortcomings of auxiliary and passive nature of traditional chemical experiments are increasingly prominent, which makes it difficult to meet the training requirements of outstanding talents. Therefore, it is particularly important to establish the knowledge system of experimental teaching through the reform of chemical experimental teaching. Based on the present situation of basic chemistry experiment teaching in local colleges and universities, this paper studies and explores the teaching of basic chemistry experiment from the aspects of innovating experimental teaching content, perfecting experimental teaching methods and improving the examination system of experimental courses, and constructs an experimental teaching system based on the cultivation of innovative ability under the background of "new engineering" to improve students' experimental interest and provide guarantee for cultivating talents with strong practical ability and innovative ability.

1. Introduction

"New Engineering" education is the direction of higher education reform at present, which puts forward new requirements for personnel training and scientific research in local universities [1]. The main connotation of new engineering is: demand-oriented, opening up schools, cultivating applied compound talents, that is, service-oriented, highlighting characteristics, and cultivating all kinds of interdisciplinary compound "excellent engineering" scientific and technological talents who meet the needs of new industries in the future, with innovative and entrepreneurial abilities, dynamic adaptability and high quality [2]. Practice is the essence of engineering and the foundation of innovation. Chemistry is not only a basic subject, but also a practical subject, which can effectively combine theory with practice and cultivate students' innovative ability, scientific research ability and comprehensive quality. Its application is extensive, involving all aspects of life. Therefore, it is of great significance to increase the proportion of experimental teaching and highlight comprehensive and designed experimental teaching [3]. This study explores the main

problems and improvement measures in basic chemistry experiment teaching in ordinary undergraduate colleges, aiming at enhancing the importance of basic experiment teaching and further promoting the improvement of teaching quality.

Basic experiment course is an important course to cultivate college students' practical ability, innovative ability and moral cultivation. Especially in the freshman stage, in the application-oriented undergraduate colleges, pharmaceutical engineering, materials science and engineering, biotechnology and other courses need to set up experimental courses, that is, basic chemistry experimental courses [4]. The basic chemistry experiment course plays a very key role in cultivating college students' practical ability, practical ability and innovative thinking ability. It is also an important link to cultivate college students' strong interest in professional learning and the basis for college students to learn subsequent professional skills. At present, the teaching of basic chemistry experiment has been reformed and the teaching effect has been improved. Basic chemistry experiment, as an important part of the basic curriculum system of some engineering majors, plays an irreplaceable role in cultivating students' comprehensive qualities such as engineering practice, scientific research innovation, organization and coordination ability. Taking this as an opportunity for reform and development, we should strengthen the innovation and upgrading of basic chemistry experiment teaching, strengthen the promotion of students' innovation and entrepreneurship ability, and promote the cultivation of talents under the background of new engineering.

2. Key Problems in Basic Chemistry Experiment Teaching at Present

2.1. The problem that the experimental curriculum is too independent

There are problems in the existing experimental curriculum, because the theoretical knowledge of the four basic chemistry is intertwined and reciprocating, while the experimental curriculum is relatively single [5]. The theoretical knowledge points that need to be verified in the two experiments should be inherited or mutually confirmed, but there is no connection in the experimental content and the expressions are scattered. The experimental course is too independent and lacks coherence, which cannot cultivate students' ability to integrate what they have learned, and at the same time cannot cultivate students' comprehensive professional qualities, such as comprehensive experimental ability, experimental design ability and research ability [6]. At the end of each experimental class, students only completed the experiment of a certain course and lacked understanding of the whole experimental course. In this way, the experimental course not only cannot fully strengthen the understanding of theoretical knowledge, but also cannot improve students' logical thinking and divergent thinking ability. Through the improvement and optimization of experimental courses, we can give full play to the role of experiments in strengthening theoretical knowledge understanding and cultivating students' scientific literacy. At the same time, it can also improve students' comprehensive ability and innovation ability and lay a solid foundation for their future study and career development.

2.2. The experimental content lacks novelty and the experimental methods are backward

The existing experimental courses are too classic, seriously out of touch with the times, and have less horizontal contact with other professional experiments, and have not fully played the role of serving the follow-up professional courses [7]. Moreover, the experimental methods are relatively single and backward, there is no introduction and use of new experimental instruments in the whole experimental course, and the experimental process lacks the links of experimental method design and personalized experimental teaching. Traditional experimental teaching is regarded as an aid to

theoretical teaching, and the experimental content and teaching mode are all focused on the verification of theoretical knowledge, with more confirmatory experiments and less comprehensive design experiments [8]. In the process of experimental course construction and teaching operation, experimental technicians lack communication with teachers, experimental teaching is out of touch with teachers' scientific research, and classroom teaching cannot be organically combined with college students' scientific and technological innovation activities, which leads to the failure to implement the teaching and research reform of experimental courses, the failure to update experimental contents in time, the failure to convert scientific research results into experimental projects, the serious shortage of comprehensive and innovative experimental projects, and the lack of students' motivation and interest in experiments. Therefore, some traditional single verification experimental teaching methods are outdated and backward, so it is difficult to arouse students' interest in participating in experimental teaching actively, and it is even more difficult to achieve the experimental teaching goal of stimulating students' innovative ability.

2.3. The experimental teaching method and assessment method are single

Limited by the traditional teaching mode, the teaching effect of basic chemistry experiments in local universities is not ideal, and the main reason is that the experimental teaching method and assessment method are single [9]. The traditional experimental teaching mode: preview before class, teachers explain the principles, instill theoretical knowledge and demonstrate the operation of instruments before the experiment begins. The teaching method is monotonous, boring and lacking in passion. Students rely more on the teacher's explanation and follow the experimental steps, lacking understanding, analysis and initiative in the experiment. After the experiment, students complete the experimental report, and the experimental teaching effect is very limited [10]. In the process of experimental teaching, the prominence of practicality leads to oversimplification in evaluating students' grades, and even an examination mode of only evaluating experimental reports has appeared, without considering the operability of practical courses comprehensively. The existence of these problems restricts the cultivation of students' innovative consciousness and the establishment of scientific spirit, and also affects the improvement of teaching quality. Experimental teaching is one of the important links of multi-specialty undergraduate education and talent training in colleges and universities, and its teaching quality is related to the effectiveness of undergraduate education and teaching. The experimental teaching in colleges and universities must adhere to the three quality construction concepts of "student-centered, output-oriented and continuous improvement" and take effective measures to improve the teaching quality.

3. Main measures of basic chemistry experiment teaching reform in colleges and universities under the background of new engineering

3.1. Reasonable design of experimental content

The experimental course is relatively simple, so students can't fully strengthen the understanding of theoretical knowledge, let alone improve their logical thinking and divergent thinking ability [11]. Therefore, it is necessary to improve the experimental course. First of all, we should strengthen the connection and cohesion between experimental courses to form an organic whole. We can consider the correlation between different experiments and the comprehensive application of corresponding theoretical knowledge points by selecting experimental content and designing experimental scheme. This can help students better understand and apply the theoretical knowledge they have learned. Secondly, we need to pay attention to cultivating students' comprehensive experimental ability, experimental design ability and research ability. In addition to completing the basic experimental

operation, we can also introduce some open experimental projects to let students participate in the process of experimental design and problem solving, and cultivate their innovative thinking and practical ability. At the same time, students are encouraged to carry out scientific research and exploration, actively participate in scientific research projects or scientific competitions, and improve their scientific research ability and scientific literacy. Finally, students need to be given comprehensive experimental course guidance. At the end of each experimental class, students can be organized to summarize and discuss the experiment, so as to promote their overall understanding and understanding of the experimental course. At the same time, relevant materials and bibliography can be provided for students to study and expand the experimental content in depth and improve their logical thinking and divergent thinking ability.

3.2. Improve teaching methods

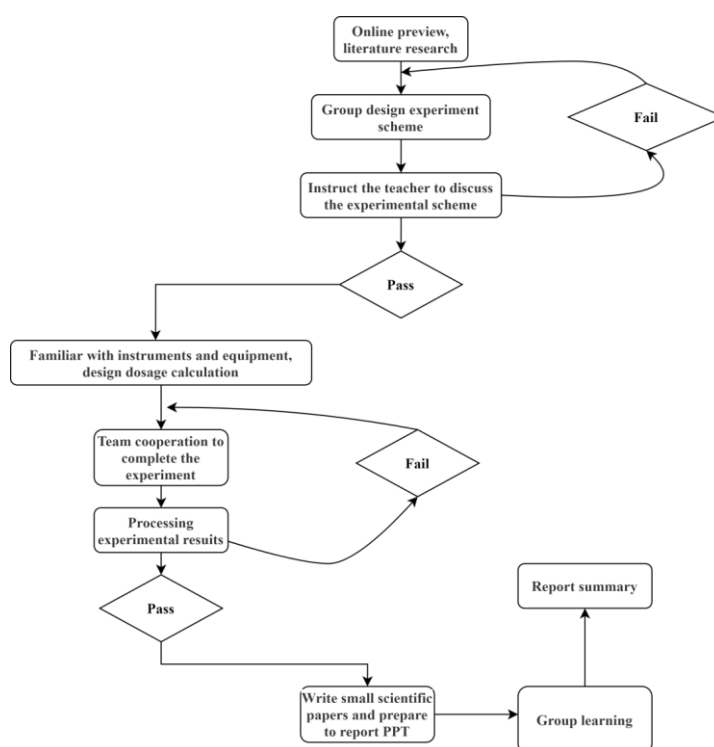


Figure 1: Training mode of students' ability to solve complex problems

In recent years, with the rapid development of information technology, teaching environment, teaching media, teaching methods and teaching resources have become more diverse, which is a challenge and opportunity for contemporary students and teachers [12]. In order to adapt to the development of the times, teachers of basic chemistry experiment courses should improve teaching methods, give full play to students' enthusiasm and initiative, and innovate the experimental teaching mode with students as the main body. In the teaching process, we emphasize the teaching concept of student-centered and teacher-led, cultivate students' ability to solve complex problems, and achieve the purpose of improving the effectiveness of experimental teaching, as shown in Figure 1. Before class, preview online and divide the students into several groups. Students are required to conduct literature research in groups, master the background knowledge and research frontiers related to experiments, and write a literature review. On this basis, the group designs the experimental scheme, and can modify the experimental scheme or the reaction conditions appropriately, and submit it to the instructor for discussion. If the teacher raises questions, the students need to further modify and improve the experimental scheme. In this way, students'

comprehensive application of theoretical knowledge can be improved and their innovative consciousness can be stimulated. Adopting experimental teaching methods with rich content, various forms and deepening levels, retaining some classic demonstration and verification experiments and increasing the proportion of comprehensive, designed and innovative experiments can not only train students' hands-on operation ability, but also cultivate their innovative thinking.

3.3. The establishment of a multi-evaluation system

Reform the experimental examination method, adopt heuristic teaching method, and strictly implement the preview system of experimental courses. The experimental examination should pay attention to not only the students' mastery of basic experimental theoretical knowledge, but also the students' proficiency in experimental operation skills. Abandon the old model such as "report-only" theory, and strengthen the investigation of students' reflection and feedback on experiments, and whether they have a rigorous scientific attitude and realistic and innovative ideology in thinking about actual production problems. The composition and distribution of the usual scores of chemical experiment courses are shown in Table 1.

Table 1: Composition and distribution of usual grades in chemical experiment courses

Evaluation time	Evaluation criterion	Appraiser	Weight
Before the experiment	Online preview situation	Instructor	5%
	The completeness and feasibility of the research scheme	Instructor	5%
	Organizational division of labor	Instructor	7%
	The completion of the work of the personnel in the group.	Team leader and team member	10%
In the experiment	Normative operation	Instructors, groups	10%
	Experimental result	Instructors, groups	10%
	Experimental safety	Instructors, groups	5%
	Laboratory hygiene	Laboratory technician	5%
	Overall performance in the experiment	Instructors, groups	15%
After the experiment	Format, quality, etc. of scientific and technological essays.	Instructor	10%
	Format and quality of PPT	Instructor	10%
	Reporting quality	Instructors, groups	8%

The total score of the experiment is "usually 70%+ final exam 30%". In the usual performance evaluation, we use multiple methods to improve the process evaluation, which mainly consists of three periods: online preview before the experiment, literature research and experimental scheme design, operational standardization, content completion and experimental results in the experiment, and scientific research papers and group reports after class. At the same time, it introduces multiple methods such as instructor evaluation, experimenter evaluation, student self-evaluation, intra-group

mutual evaluation and inter-group mutual evaluation, and also pays attention to PPT production ability and language expression ability. The results show that the process evaluation can stimulate students' learning interest and initiative, effectively improve the learning effect and teaching quality, comprehensively and objectively evaluate students' scientific research literacy and innovation ability, and truly reflect students' basic situation.

4. Conclusions

Under the background of new engineering, the general task of basic chemistry experiment teaching should be to cultivate practical and applied students, integrate "theory, specialty, curriculum, structure and integration", explore the practice of "new engineering", strive to achieve the excellent goal of "tamping foundation, improving theory, strengthening practice, being innovative and educating new people", and cast a new era and new engineering. Through the reform of chemical experiment teaching, this paper aims to establish a chemical experiment teaching mode combining theoretical knowledge with experimental knowledge, improve the role of "integrating theory with practice" in experimental courses, strengthen students' understanding of theoretical knowledge, cultivate scientific consciousness, improve innovation consciousness, and then cultivate more outstanding chemical talents to promote the development and progress of national chemical industry.

Acknowledgements

Special subject of art education in Shandong province<<Exploration and Practice on the Application of WeChat Public Platform in Basic Chemistry Experiment Teaching in Colleges and Universities>> (Number: L2022Y10180012).

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