

Exploration on the cultivation of innovative talents in the course of chemistry teaching

Nailiang Liu^{1,*}, Shasha Li², Junpeng Li¹, Ningning Zhao¹, and Zhong Yu¹

¹Department of Applied Chemistry, School of Science, Xi'an University of Technology, 710048 Xi'an, Shaanxi, China

²Faculty of Printing, Packaging Engineering and Digital Media Technology, Xi'an University of Technology, 710048 Xi'an, Shaanxi, China

Keywords: Teaching reform, Chemistry courses, Innovation ability, Engineering colleges.

Abstract. Cultivating innovative talents to meet the needs of professional development is an urgent mission of higher education institutions under the situation of "Double First-Class" construction. As one of the foundations of science and technology major, chemistry courses play an essential role in promoting an innovative spirit, cultivating creative consciousness, and improving creative ability. This paper discussed the optimization of the curriculum system, the construction of the teaching mode, and the transformation of the cultivation mode of chemistry courses in engineering majors from the aspects of curriculum design, theoretical teaching, experimental teaching, and out-of-class training. Through cultivating innovation consciousness in theory and experimental teaching, and improving innovation ability in extra-curricular practical education, we hope to bring a positive effect on the reform of the cultivation mode of innovation ability in the teaching process of chemistry courses in engineering colleges and universities.

1 Introduction

It is the most important goal of contemporary higher education institutions to stimulate the innovative ideas of talents, cultivate their innovative consciousness, improve their innovative ability and create innovative talents who can adapt to the development of modern society in the process of teaching and educating people ^[1]. The thinking and methods of chemistry for the understanding and exploration of the world cannot be replaced by other disciplines, and the learning of chemical knowledge plays an important role in the cultivation of innovative talents ^[2]. Chemistry is the science of chemical disciplines that are based on the study of principles, laws and methods of the chemical behaviours of objective material systems. It covers the study from macroscopic to microscopic, the laws of the relationship between structure and properties, the mechanism of chemical processes and

* Corresponding author: liul-2001@163.com

their control, and is the theoretical basis for chemistry and the study of material change at the molecular level, and is the core basic course for chemistry, chemical, biological, materials, mechanical, energy, environmental and other majors in higher education [3], which plays a vital role in the cultivation of innovative talents.

2 Integrating innovative ideas in the course design

The chemistry courses of Xi'an University of Technology are set up for all majors in the university, which are conducive to enhancing students' understanding and knowledge of chemistry, and are compulsory for majors in energy, materials, environment, pharmaceuticals and chemistry. The purpose of the course is to enable students to understand and master the basic knowledge and skills of chemistry, and to cultivate their scientific thinking methods and analytical and problem-solving abilities. In the process of learning the course to improve students' scientific literacy, enhance their ability to innovate and entrepreneurship, so that they can better adapt to the development of society while stimulating students to appreciate the knowledge of chemistry, and love the emotions of the chemical profession. The course design uses a combination of forms to enrich classroom content, stimulate learning interest, and enable students to develop in a harmonious and unified manner.

2.1 Knowledge and skills

Understand chemistry in daily life and the essential principles of chemical knowledge; understand the process and methods of experimental design and master the necessary experimental skills through consolidation of experimental teaching; understand the basic knowledge of chemistry and its related disciplines and be able to analyse and solve problems in chemistry; understand the frontier scientific and technological developments in the development of chemistry and have enthusiasm for the learning of chemical knowledge.

2.2 Processes and methods

Through the whole process of chemistry theory and experimental teaching, learn to use the method of scientific investigation, and form the spirit of teamwork in practical activities; form the awareness of explaining and solving chemical phenomena and chemical problems encountered in life with scientific attitudes and methods, learn to collect data, analyse data, and develop good habits of problem identification and problem-solving.

2.3 Emotional attitude and values

Students are interested in exploring the effects of chemistry on environmental changes, understanding the role of chemistry and the chemical industry in promoting social development, and developing an interest in studying chemistry; developing a love of life, cherishing life, dedication, and dedication to work, viewing the relationship between chemistry and the environment, chemistry and human society correctly, and pursuing the ultimate goal of chemistry in the service of mankind.

The construction of chemistry courses combines the professional curriculum, the layout of the knowledge system and the characteristics and advantages of related majors, highlighting the basic theoretical knowledge, applied technology and the policy of comprehensive ability cultivation. It promotes the cultivation of students' innovative ability, perfects the comprehensive knowledge system and improves the comprehensive

professional quality. At the same time, the construction and implementation of these courses are of great significance in giving play to professional characteristics, optimizing professional layout, building and enhancing professional advantages, cultivating innovative talents, and promoting professional construction and the healthy and sustainable development of talent training.

3 Establishing the spirit of innovation in theoretical teaching

Teaching content is the key and core of the curriculum, and it is the basic guarantee and concrete embodiment of the goal of cultivating innovative talents ^[4]. Chemistry courses contain conceptual, theoretical, systematic and logical contents, which involve many formulas in the learning process, harsh application conditions, relatively abstract and difficult to learn. The theoretical teaching process in chemistry class courses is aimed at imparting basic knowledge, cultivating chemical quality, and improving innovative ability. The curriculum is designed to reorganize the lecture system of chemistry courses, focus on summarizing experience, improving teaching methods and optimizing the teaching process. We introduce the history of science and modern scientific and technological achievements and frontier developments appropriately to broaden students' horizons, stimulate their enthusiasm and interest in learning, and improve their autonomy. In each teaching session, a systematic knowledge framework is constructed and teaching objectives are clearly defined. In the process of theoretical teaching, students are motivated to learn, guided to think differently based on theoretical learning, and to learn independently by applying the same knowledge to the learning content.

3.1 Linking teaching content with daily life

Although chemistry courses are very theoretical, systematic and logical, they still have very concrete manifestations in all aspects of daily life, which can link some difficult to understand abstract concepts to phenomena in daily life, deepen students' understanding of the concepts and increase their interest in learning.

3.2 Linking teaching content with scientific research topics

Theoretical teaching process interspersed with the relevant scientific research content in the department, these can see and hear the content, not only can expand the students' knowledge, but also enrich the classroom teaching, but also help to improve the students' interest in learning, and participate in scientific research activities enthusiasm. By linking the teaching content with relevant research topics, students can ask the relevant teachers for more in-depth information, which will more effectively promote students' enthusiasm for learning and research, and help improve the teaching effect.

3.3 Linking teaching content with industrial development

Taking the cultivation of engineering innovative talents as the starting point, we pay attention to the accumulation of relevant knowledge of engineering technology background, the exercise of creative thinking, and the cultivation of self-learning ability. Introducing the actual production of enterprises into the teaching of chemistry courses not only enriches the teaching content, but also enhances students' knowledge of industrial production and helps link theory and practice. By linking the teaching content to the actual production process,

students improve their understanding of the theoretical basics, understand the relationship between theory and practice, and expand their knowledge of chemistry.

4 Cultivate the sense of innovation in experimental teaching

The driving force of scientific development comes from experiments, and the new phenomena, new methods and new theories discovered by experiments promote the progress of science and gradually revolutionize mankind's understanding of the objective world. Experiments in chemistry courses are used to study the chemical properties of substances and the relationship between these properties and chemical reactions through experiments, from which regular understanding is formed and students master the relevant theories, experimental methods and experimental techniques in chemistry. Through experimental teaching, students can verify and consolidate theories and concepts, deepen their knowledge of theoretical fundamentals, improve their ability to understand, analyse and solve problems, promote teamwork, and strengthen the cultivation of students' creative consciousness and innovative ability.

To stimulate students' enthusiasm for learning chemistry courses, students should be given more autonomy and flexibility in experimental settings, and experimental teaching should be reformed by adhering to the concept of student-oriented "subjective education" [5]. In the reform of experimental teaching of chemistry courses, the experimental content can be reformed to take into account both consolidation of the basics and expansion of the content, and adopt a three-stage teaching mode consisting of basic experiments, application experiments and comprehensive experiments. Condense the basic experiments to cultivate students' basic operation skills in chemistry experiments and strengthen their basic training; expand the comprehensive experiments so that students have more choices and exercises to improve their application ability to apply basic knowledge of chemistry to analyse and solve problems; set up open experiments, which require students to complete the whole process of experiments independently and cultivate students' ability of comprehensive application of chemical knowledge and innovative design ability.

5 Improving innovative ability in extra-curricular practice

In the teaching process of engineering chemistry courses to cultivate innovative talents to meet the needs of social development, in addition to building an innovative talent cultivation system, it is also necessary to gradually enhance talents' innovative consciousness, cultivate innovative thinking and improve innovative ability in innovative practice. Therefore, while reforming in-class teaching, students should also be vigorously guided to participate in extra-curricular practice. The learning and penetration of innovative quality are carried out in the in-class teaching, and the cultivation and improvement of innovative ability are carried out in the concrete practice. Students gradually acquire innovative abilities through systematic scientific and standardized training in concrete practice. And they can get in touch with the frontier knowledge in the professional field and understand the advanced new ideas, technologies and methods. It helps to broaden knowledge, improve knowledge structure, stimulate innovative ideas and cultivate innovative consciousness. In the process of extra-curricular practice, we should follow the objective rules from simple to complex, from known to unknown, and exercise from information collection, scheme design, experiment optimization, data recording, result analysis, paper writing, product improvement and other aspects, accumulate practical experience and improve innovation ability in the process of continuous trial and error and improvement, thinking and enhancement.

6 Conclusion

The cultivation of innovative talents is an important task given to higher education by society under the situation of double-class construction. As an important part of higher education, higher education institutions should take the establishment of innovative spirit, cultivation of innovative consciousness and improvement of innovative ability as the main purpose of talent cultivation in educational reform. Chemistry courses are important basic courses for chemistry, chemical engineering, biology, materials and other majors in engineering colleges and universities, which are of great significance for the cultivation of innovative talents. Through reforming the teaching mode of curriculum design, theoretical teaching, experimental teaching and extra-curricular teaching, recognizing and cultivating innovative consciousness in theoretical teaching and experimental teaching, and practicing and improving innovative ability in extra-curricular teaching, the strategy of cultivating innovative talents in engineering colleges is constantly improved.

Education and Teaching Reform Research Project of Xi'an University of Technology (xjy2152)

References

1. K. Wang. *Tu. Chem. Eng. (China)*. **50**, 10 (2022)
2. X. Feng. *Chin. J. Chem. Educ.* **40**, 2 (2019)
3. Y. Su, C. Zheng. *Univ. Chem.* **35**, 6 (2020)
4. Y. Shen, Y. Wang, J. Li, J. Chang, F. Zhang. *Univ. Chem.* **33**, 9 (2018)
5. X. Wang, X. Wang, X. Wang, F. Tian, X. Tian, B. Chen. *Univ. Chem.* **34**, 11 (2019)