Adult and Higher Education (2023)
Clausius Scientific Press, Canada

DOI: 10.23977/aduhe.2023.052008
ISSN 2523-5826 Vol. 5 Num. 20

Exploration of Experimental and Practical Teaching System for Chemical Engineering and Technology in Applied Universities under the Background of New Engineering

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Keywords: Chemical engineering and processes, experimental and practical teaching, mode, new engineering

Abstract: Based on the background of the new engineering discipline, the characteristics of the chemical engineering and technology major, and the actual situation of this major, and based on the characteristics of the chemical engineering and technology major and the problems existing in the practical teaching process, a practical teaching system with experiments, internships, designs, scientific research activities, and competitions as the main content is proposed. A progressive practical teaching model is constructed, which includes foundation, engineering, improvement, research, and creation, The teaching effect proves that the current practical teaching system for the Chemical Engineering and Technology major in our college is complete and effective, the teaching mode is in line with reality, the teaching effect is good, and the direction of practical teaching for the Chemical Engineering and Technology major has been explored. Emphasis should be placed on the status and role of practical teaching, as well as its systematic and complete nature, in order to unify practical teaching with theoretical teaching.

1. Introduction

Practical teaching is an indispensable and important part of talent cultivation in higher education. Reforming and improving the engineering practical teaching system, exploring new models and methods of practical teaching, is one of the important problems faced by higher education in China[1]. Reforming and improving the engineering experimental practical teaching system, exploring new models and methods of practical teaching, is also a task and requirement of the construction of new engineering disciplines[2]. As a typical engineering major in Mount Taishan University, a regional application-oriented university, the chemical engineering and technology major explores, researches and implements the experimental and practical teaching mode that meets the requirements of new engineering construction, which is in line with the school's positioning and talent training requirements. Based on the current situation of practical teaching in the field of chemical engineering and technology and the requirements of the new engineering background for practical teaching in engineering, combined with the development ideas of applied universities,

after a long period of practice and summary, we have developed a practical teaching system for chemical engineering and technology, which mainly includes experiments, internships, design, scientific research activities, and competitions. We have constructed a basic, engineering, improvement, research Create a progressive practical teaching model, enhance the position and role of practical teaching in the entire curriculum system, regard practical teaching as a system of the entire teaching system, emphasize its systematicity and completeness, and enable students to receive systematic training in various practical aspects.

Based on the goals and tasks of the construction of new engineering disciplines and the development requirements of applied universities, we have timely revised the training plan, combined with the current situation of experimental and practical teaching, and established basic experiments and professional experiments in the Chemical Engineering and Technology major; Understanding internships and production internships; Skills competitions and design competitions; Technological research and innovation activities; Practical teaching activities such as professional course design and graduation project.

2. Experimental and practical teaching system

2.1. Basic and professional experiments

2.1.1. Laboratory construction

The part of the teaching system that provides students with basic experimental training in the co engineering and process experiments of basic experiments and professional experiments. My major has completed four basic chemical experiments, including Chemical engineering experiments, such as chemical principles experiments, fine chemical process experiments, reaction engineering experiments, etc; Chemical simulation experiments, etc. The experiments assist students in transforming their theoretical understanding of professional knowledge into practical skills, and cultivate their ability to be meticulous, observant, apply theory to practice, and analyze and solve problems. These abilities will also integrate into other related experimental and practical teaching processes and activities.

The practical teaching of this part is undertaken by the experimental center or experimental and practical base established according to the discipline. Our college's Chemical Principles Laboratory, Reaction Engineering Laboratory, Chemical Simulation Laboratory, and Fine Chemical Technology Laboratory undertake the traditional experimental teaching tasks of students majoring in Chemical Engineering and Technology, especially the chemical simulation experiments offered in recent years. They can not only complete the simulation of chemical unit operation simulation, chemical production process simulation, pharmaceutical simulation, chemical principles experiment simulation, chemical laboratory safety simulation, and other experiments, And the DCS control system used highly overlaps with the actual production of the enterprise. Through simulation experiments, students not only achieve simulation of the experimental process, but also have a further understanding and understanding of the actual production conditions of the enterprise. The chemical simulation experiments also lay a foundation for students' later internships, graduation projects, competitions, and scientific research activities.

2.1.2. Reform the experimental teaching process and cultivate students' practical abilities

We have focused on building a number of on campus experimental bases. Experimental teaching is an important means of cultivating students' hands-on ability. The established campus experimental and practical bases include basic experimental centers, chemical engineering

professional experimental centers, and campus internship simulation bases. Laboratories should not only serve a certain type of discipline. The experimental center should be built as a base for practical teaching, open innovation laboratories to students, and allow them to enter the experimental teaching base. Through a series of scientific research, competitions, and innovation activities, the functions of the laboratory should be fully utilized, and the innovation ability and research level of students should be improved. The concept and pattern of the laboratory serving theoretical course teaching should be changed, reflecting the role of the experimental teaching base.

Strengthen comprehensive and designed experiments. To cultivate students' practical abilities and innovative spirit, further expand the proportion of comprehensive and designed experiments. Its purpose is to cultivate students to comprehensively apply relevant theories and professional knowledge to solve practical problems, establish correct design ideas according to scientific research methods, and further improve their ability to analyze and solve practical problems. The purpose of ordinary chemical engineering experiments is to promote students to deepen theoretical knowledge, master experimental skills and methods, cultivate scientific thinking habits and rigorous work styles. The implementation of comprehensive and design experiments can change passive thinking patterns, change indoctrination based teaching, and truly improve students' ability to think and solve problems[3].

2.1.3. Establish a campus simulation laboratory to improve the quality of experimental teaching.

Simulation experiments can complete typical chemical unit operations, such as distillation, absorption, fluid transportation, extraction, tube heating furnace, and 18 other unit operations; Representative production sections, such as polypropylene polymerization process simulation, phthalic anhydride process simulation, penicillin production process simulation, and other production process simulation experiments; Membrane separation, series reactor backmixing performance, ethylbenzene dehydrogenation, CO shift and other reaction engineering experiments; Simulation experiments such as chemical principle experiments use simulation software to comprehensively control and adjust process parameters, simulate various phenomena, handle various unexpected situations, and fully experience the complexity of actual industrial processes in the simulated industrial process.At the same time, students can better complete the learning from subject basic courses to professional basic courses and even professional courses in this simulation scenario, and their understanding of theoretical knowledge will also be deeper[4].

2.2. Construction of internship bases

Internship is the part of experimental and practical teaching that provides students with engineering practical training. It mainly includes metalworking internship, electrician internship, cognitive internship, production internship, graduation internship, etc. The teaching purpose is to comprehensively cultivate students' practical abilities and engineering qualities that are close to reality. In recent years, we have established on campus metalworking internship bases and electrician internship classrooms. Students can learn and operate basic workshop tools such as lathes, welders, and fitters on campus, and can independently complete the welding, assembly, and debugging of various electronic components according to the circuit board. This has greatly improved our engineering practice ability and engineering literacy. In addition, we have cooperated with chemical enterprises and established several internship bases, such as Huayang Pesticide Weifang Puluo Hanxing, Qingdao Runnong and other enterprises. Every year, more than 300 people go to the internship base to participate in recognition internships, production internships, and graduation internships. More than 20 teachers and students engage in in-depth enterprise off the job

learning for more than half a year, and their professional qualities and knowledge have been greatly improved.

2.3. Course Design and Graduation Project

2.3.1. The role of course design and graduation project

The role of curriculum design and graduation project is to provide students with practical training to improve their practical skills in practical teaching. It is a comprehensive practical teaching process that continues, deepens, and tests the early stage of teaching, mainly including curriculum design, graduation thesis, graduation project, etc. Its teaching objective is to improve students' professional subject level, hands-on thinking ability, and problem-solving ability, and integrate them into extracurricular scientific and technological activities in practical teaching activities such as technology competitions and innovation research training for college students. We attach great importance to the graduation design process, strengthen the monitoring of graduation design, establish a three-level quality monitoring system for graduation thesis, including guidance teachers, departments, and schools, assign responsibilities to individuals, ensure the quality of graduation design, and encourage students to complete their graduation thesis (design) in work and internships.

2.3.2. Carefully select topics and strengthen the management and guidance of graduation design

The graduation project topic is subject to strict review. The graduation project topic and requirements directly affect the process and effectiveness of the graduation project. We strictly review the graduation project topic, including the following aspects: the topic must meet the basic teaching requirements, start from the professional training objectives, which is conducive to consolidating, deepening, and expanding the professional knowledge learned by students; The topic selection should be closely combined with the characteristics of the major, so that students can exercise their ability to independently engage in scientific research in the six-month graduation project; The selected topic can reflect the development trend and level of the discipline; The weight and difficulty of the project should be appropriate, so that students can complete it within the specified time and with effort; The selection of topics should also consider the differences among different students, in order to promote strengths and avoid weaknesses, and teach according to individual needs; For individual students with special interests and excellent grades, topics closely related to the training objectives can be selected.

Monitoring the entire process of graduation design. Teachers pay attention to the cultivation of students' abilities in guiding the graduation project process, including the ability to comprehensively apply the basic theories, professional knowledge, and basic skills of their major, the ability to analyze and solve problems comprehensively, the ability to conduct research, the ability to consult domestic and foreign literature, the ability to formulate experimental plans and process data, the ability to process computers, the ability to write papers, and the ability to innovate. In order to improve the quality of graduation design, teachers strictly control and provide careful guidance from various stages such as proposal proposal, scheme formulation, experimental implementation, progress, thesis writing, and graduation defense. They propose solutions to existing problems.

2.4. Scientific research activities

This is a part of the practical teaching system that provides students with research-oriented training, including various club activities, scientific research activities, laboratory opening,

participation in teacher research, participation in the Challenge Cup College Student Science and Technology Competition, and other forms of completion. Practical teaching should adapt to the needs of the times for talents, create an extracurricular scientific research atmosphere for students, and enhance their scientific research awareness. Our leaders, teachers and students fully recognize the importance of scientific research activities in student practical teaching. Through conducting experimental skills competitions, scientific and technological innovation competitions, and applying for research projects, we further promote extracurricular scientific research and technological activities for college students in our major. By establishing student science and technology clubs and establishing science and technology activity bases in teaching and research rooms and laboratories, we can strengthen the cultivation of students' scientific and technological innovation abilities. Participating in scientific research activities is beneficial for students to improve their hands-on and brain skills, understanding of professional knowledge, and ability to analyze and solve problems. The understanding and application of knowledge in chemical engineering and technology are based on a large number of experiments, and the learning of various professional knowledge also serves experiment and practice. Therefore, encouraging students to participate in scientific research activities during the university learning stage is of great help to their learning, further education, and employment. In recent years, our students have won many awards in the Challenge Cup Undergraduate Extracurricular Academic Works Competition and the Internet plus Innovation and Entrepreneurship Competition, which also proves that the practical teaching method of leading and encouraging students to participate in scientific research activities is effective.

2.5. Competition

Encourage teachers and students to participate in various subject practice competitions and selections, such as chemical experiment skills competitions, chemical experiment competitions, chemical design competitions, and Challenge Cup extracurricular academic and technological works competitions for college students. This belongs to the creative practice training part of practical teaching. Encourage students to actively participate, explore, think, and practice, in order to achieve comprehensive development of students' abilities in multiple aspects. In long-term practical exploration. We have established a mechanism for teacher-student competition participation, which promotes learning through competitions, excellence through competitions, evaluation through competitions, and promotion through competitions. The enthusiasm for participating in competitions among teachers and students has been high, and their achievements have been remarkable. The overall professional competence of students has been comprehensively improved. In recent years, students in our college have achieved excellent results in various competitions such as the Chemical Experiment Skills Competition, Chemical Experiment Competition, Chemical Design Competition, and Challenge Cup. This proves that the competition practice teaching model we have explored and established is effective and greatly helps students in their independent learning.

3. Share our experience

Currently, increasing the proportion of computer problem-solving content and chapters in professional courses is one of the trends in the design of chemical engineering courses. However, according to the summary report of the curriculum evaluation of various schools in previous years by the National Teaching Guidance Committee for Chemical Engineering Principles, in recent years, only some schools have used computers in simulation experiments and curriculum design such as chemical engineering principles, chemical thermodynamics, chemical design, and chemical instrumentation. According to the new form, computer chemical simulation and control practical

courses should be constructed, including process simulation, process design, process simulation and control, etc., to improve students' computer application level. Applying modern educational technology and computer simulation technology to practical teaching of chemical engineering. One is to leverage the advantages of computer information transmission methods, develop multimedia and online courseware for chemical engineering courses, including experimental course courseware, to visually simulate the experimental and practical processes, making the process intuitive and improving students' understanding of the experimental process. The second is to leverage the functions of computer-aided teaching and establish a vast and widely used computer-aided practical teaching system.

However, the problem that arises during the learning process of chemical engineering courses is precisely the separation of computer knowledge and professional knowledge. Computer knowledge is difficult to apply in practical applications such as experiments, course design, and graduation projects, and cannot be used to solve practical problems. In the teaching of professional theoretical courses, due to course design and other reasons, there is less or even no computer training, resulting in a disconnect between computer courses and professional subject courses. How to provide students with better training and continuously improve their computer application level is a problem that chemical engineering courses must face. In addition, one of the trends in curriculum reform is to appropriately reform the teaching objectives and plans of computer teaching during the basic course learning stage, combine them with the major, and strengthen the penetration between disciplines.

In response to the current situation of offering computer courses in the field of chemical engineering, we have expanded the proportion of computer problem-solving experiments in the experimental stage of professional courses, such as chemical principle experiments and course design, chemical design, chemical thermodynamics course teaching and course design, etc. We have planned and purposefully increased the proportion of computer practical teaching, and strengthened the application ability of computer technology in solving practical problems in chemical engineering. For example, computer programs can be used to solve equipment design problems in the course design of chemical engineering principles, solve the equation of state in chemical thermodynamics, and calculate gas-liquid equilibrium using the equation of state. Design softwares are used for process optimization, process simulation, and process calculation in chemical engineering design. In terms of courses, computer-aided design for chemical engineering has been offered, and practical teaching courses such as "Aspan Plus" have been offered on the use of computer chemical engineering software, integrating theoretical teaching with computer practical teaching and practical teaching such as course design and graduation project. Another important aspect of computer practical teaching is the cultivation of computer numerical analysis and data processing abilities, the use of computer experimental scheme design, and the processing of experimental data. This is also an important aspect of practical teaching. Integrating computer practical teaching with experiments, extracurricular research activities, graduation projects, and other processes is helpful in improving students' professional literacy and computer application level.

As teachers, we also timely impart and explain the application of computer technology in chemical production to students in the process of theoretical course learning, impart corresponding concepts and technologies, promote and utilize computers as modern teaching methods, promote the process of school teaching reform, promote the construction of curriculum system, and change the current situation of outdated teaching content, rigid teaching methods, and outdated teaching knowledge, Enhance students' practical ability to utilize computers to serve their major and integrate them into other related practical teaching processes and activities. At the same time, this also puts high demands on the computer technology and application ability of teachers.

4. Conclusion

In summary, We have practiced four directions for experimental and practical teaching in the field of chemical engineering and technology under the background of new engineering. Firstly, with the goal of cultivating students' practical and innovative abilities, we should adjust the training plan and design teaching content, teaching methods, and teaching methods based on the current situation of experimental and practical teaching, professional characteristics, disciplinary characteristics, and development trends. We should promote the optimization of experimental and practical teaching mode and further unify and optimize it with theoretical teaching in teaching content and teaching hours, establish the reform of experimental and practical content, methods, and means on the modern educational technology platform, adapt to the trend of widespread application of computer technology in the field of chemical engineering, and apply computer technology, modern educational technology, simulation technology, etc. to the process of experimental and practical teaching. The second is to attach importance to the important support of practical teaching bases, including on campus and off campus internship bases, on campus experimental centers, and on campus simulation laboratories. By establishing and improving experimental and practical teaching bases, teaching can be implemented effectively. The third is to attach importance to the promoting effect of competitions on students. Participating in competitions not only enhances students' creativity, hands-on and brain skills, analytical and problem-solving abilities, but also exercises their engineering thinking and enhances their engineering literacy. The fourth is to change the traditional view that practical teaching only serves as an auxiliary and supplementary part of theoretical teaching, and to attach importance to practical teaching. The unity and coordination between theoretical teaching and practical teaching should be attached importance to, so that practical teaching and theoretical teaching are mutually coordinated in terms of teaching content, teaching methods, etc.

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