

Practice and Application of Case-Based Teaching Method in Chemical Engineering Safety Course

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ABSTRACT

This paper mainly introduces the application of case-based teaching method in chemical engineering safety course, makes full use of case-based teaching, breaks the traditional teaching method of chemical engineering safety course, this paper analyzes the importance of chemical industry safety with video and image data of real cases, popularizes the professional prevention knowledge of chemical industry safety, and constantly improves the safety and environmental protection consciousness of students, and constantly strengthens the safety responsibility consciousness of students. Through the reform of the Case method, the students can really participate in the teaching, and through a case study, they can communicate with the instructors. The two-way teaching mode also puts forward higher requirements for the teachers, and it has helped the teachers to keep improving.

Keywords: case-based teaching, chemical engineering safety, practice, application

I. INTRODUCTION

"Chemical Engineering Safety" is a professional elective course for process equipment and control engineering, with a total of 16 class hours, 1 credit, and starting in the junior year.

This course mainly introduces the hazard classification and characterization of chemical substances, the maintenance of chemical equipment and the safety of public engineering facilities, the safety management of chemical enterprises and the typical safety accidents in the chemical industry. Through the analysis and discussion of safety cases in the chemical industry, students are allowed to correctly understand the advantages of chemical process parameter setting and optimization, be familiar with the necessity of chemical equipment operation and maintenance management, and understand the indispensability of various properties of chemical raw materials.

II. THE FOUNDATION OF COURSE CONSTRUCTION

A. Cooperation between curriculum construction and other universities and enterprises

In the process of constructing this course, the school cooperated with Henan Yongyin Chemical Industry Co., Ltd. and Henan Qing'an Chemical High-Tech Co., Ltd., and invited the companies' senior executives to the school to communicate, guide, and analyze cases for

students. It is conducive to students' in-depth study and application of this course.

B. Construction of related course resources

1) *Materials in chemical accident cases are rich:* The members of the project team have rich experience in engineering practice, and there are rich case materials accumulated for many years for the application of this course.

2) *Samples for study, discussion and comments are enough:* The people involved in this course collected all kinds of chemical engineering safety accidents caused by chemical production, processes, raw materials, etc., as teaching materials for discussion and application.

3) *Teachers are experienced:* The project team members have rich teaching experience, understand the characteristics and deficiencies of students, and have the ability to guide students to discuss, guide correctly, and summarize and make comments; project team members have also undertaken a number of educational reform projects and have sufficient experience to complete this project.

The persons in charge of the project have rich experience in engineering practice. During the course guidance, they attach importance to the connection and application of theory and engineering practice. At the same time, they have accumulated many years of chemical safety engineering cases, videos and other materials for the analysis of this course.

4) *Reference materials are rich*: 4 kinds of paper and 3 kinds of networks, a total of 7 types of teaching reference resources are provided to students for application, enough to meet the needs.

III. COURSE REFORM IDEAS

A. *The positioning and reform goals of the expected audience of the course*

About the positioning of the expected audience: there are about 68 students in the sophomore to senior undergraduate majors in the field of processing equipment and controlling engineering and chemical engineering.

B. *Reform goals*

The reform goals include the following aspects:

- It needs to break the traditional teaching model, take "student-centered" and "teacher-led" as the basis of the seminar, and develop the students' ability to think seriously, communicate actively and exchange.
- Case teaching focuses on two-way communication to enable students and teachers to promote each other, breaking the traditional "teacher-led" teaching model, allowing students to really participate in teaching. Through case-by-case analysis, the two-way teaching format also puts forward higher requirements for teachers.
- Case teaching enables students to think independently and is full of learning fun. It enables students to change from "passive" learning to "active" learning, which greatly improves students' enthusiasm and initiative.
- It needs to change the focus on knowledge to focus on ability enables students' quality education to be reflected, and further allow students to combine theoretical knowledge with practical cases of chemical engineering safety analysis.

C. *Course reform program*

1) *Establishing a classic teaching case database of chemical engineering safety*: The cases should be representative, true and credible, objective and vivid, and of moderate difficulty. It not only can refer to the

undergraduate "Chemical Engineering Safety Technology" case, but should be suitable for applying the characteristics of technical students, and edit the case appropriately to make it more suitable for the learning of process equipment and control engineering students. Moreover, the content of the case database is kept updated at a certain rate every year, so that the case has the characteristics of times[1], [2].

2) *Composing high-quality textbooks*: The chemical engineering safety textbook has been approved as the second batch of innovative textbooks of the Huanghe S&T University in August 2017.

Before the first draft has been basically completed, it is conducive to guiding the smooth development of the case teaching reform of this course.

3) *Inviting senior technical managers of the company to give a lecture on chemical engineering safety*: Inviting chemical enterprise personnel to give special lectures during the course of teaching will help students to learn and master chemical engineering safety knowledge in depth and lay a solid foundation for their future employment [3].

IV. TEACHING IMPLEMENTATION EFFECT

Through the collection and analysis of various chemical engineering safety accident cases, students can change from passive learning to active learning, which can enhance self-acquisition and application of knowledge, communication and organizational skills, and are conducive to the development of independent personality. First of all, students have mastered the methods and ways of collecting knowledge, and have enhanced the ability to acquire knowledge by themselves and comprehensive application of knowledge.

They can also learn how to sum up experience from practice, and rise to the theoretical level, which strengthens the ability of combining theory with practice.

Secondly, due to the analysis of chemical safety accident cases, more attention is paid to the process of drawing conclusions, which also improves the students' logical thinking and comprehensive analysis and problem solving skills; students explain, discuss, and analyze accident cases through the classroom, which improves language expression ability, quick response ability, communication and cooperation ability with the people around them, and organizational management ability. Finally, case-based teaching encourages students to think independently, to be innovative, to train students' divergent thinking, and their abilities to observe and analyze problems from multiple angles and levels and observe comprehensively.

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Teachers are leaders and promoters of case-based teaching activities, and they need to always control the progress and direction of class discussions. Therefore, for teachers, the case-based teaching method is an update of educational ideas and concepts, which puts forward higher requirements on the breadth of teachers' professional knowledge, teaching organization ability and teaching skills, and the update of teaching concepts.

The first is to talk about the breadth of teachers' professional knowledge. Teachers usually promote the continuous updating of their own knowledge structure and the continuous improvement of the course content by carefully collecting and accumulating case materials and integrating the accident cases collected by students outside the classroom. Through the implementation of case-based teaching, teachers can also enhance the ability of logic analysis, the ability of summarizing key points, and the ability to integrate theory and practice. The second is to talk about the ability and skills of teaching organization. Teachers have changed from traditional knowledge imparters to student learning organizers and guides. They need to consider the implementation process of case-based teaching and formulate detailed implementation plans and make sure of the adopted methods and steps. Therefore, case-based teaching can enhance teachers' ability to analyze and solve new problems in the process of teaching in a timely manner, and control the adaptability in classrooms. Finally, it is to talk about the updating of teaching concepts. The implementation process of case teaching is also an interactive process of teacher-student communication and common development. It changed the teachers' previous concept of self-reliance, strengthened the teaching concept of carefully listening to students with different opinions, gave students self-confidence and respect, established a correct outlook on students, and realized two-way communication between teaching and learning.

In short, case teaching has changed the traditional "indoctrination" teaching method. It is case-centered, realizing a knowledge-centered to ability-centered education transition, allowing students to always take lessons to study with questions, fully mobilizing students' enthusiasm for independent learning, and promoting the students' understanding and mastery of the abstract and conceptual teaching content, which makes teaching effect been greatly improved. The student's conscious attendance rate is over 95%, and the average passing rate at the end of the semester is over 90%. The number of students actively participating in the teaching process has been greatly improved, and students' creative ability and ability to solve practical problems have been cultivated. This shows that the case-based teaching method is very suitable for the cultivation of compound innovative talents. Through the implementation of case-based teaching, teachers can increase the breadth of professional knowledge,

strengthen teaching organization and teaching skills, and promote the updating of teaching concepts.

V. TEACHING EVALUATION

A. Student evaluation

1) *Chen Wenhui (1601181043)*: The case teaching method is well reflected in the chemical safety course. The teacher combined with vivid chemical production safety cases to explain, making everyone feel more intuitively what safety is. Although there are not many hours of chemical engineering safety courses, people can learn a lot from it.

2) *Zhang Chengwei (1601181052)*: Fresh cases can better stimulate everyone's interest in learning. In every class, the teacher basically takes the case as an introduction and tells us the importance of chemical engineering safety. The case teaching method is conducive to the memory and understanding of chemical engineering safety knowledge.

3) *Ping Xiaoqian (1601181011)*: During the class, the analysis and explanation of the case as the main line is conducive to our learning and understanding. People understand that in the future production process, they must establish a sense of safety precautions, take responsibility for themselves, and do a good job in pre-job safety training.

B. Peer evaluation

The course is closely integrated with student employment: the courses taught are closely connected with the related chemical companies in the future employment of students. Through the vivid cases, coupled with the interactive communication between the classroom and the students, it can continuously cultivate students' comprehensive ability of serious thinking, active discussion, active analysis of problems, and problem solving, which beneficially support the work needs of students after graduation requirements.

C. Evaluation of the school teaching supervision group

"Chemical Engineering Safety" course reform, focusing on case-based guided teaching method, provides a good discussion and communication platform for students, and it has a good guiding role in cultivating students' ability to think positively and actively analyze and solve practical problems.

D. Overall evaluation

The topic selection of this project has strong practical value. The reform and research of chemical engineering safety case teaching in this project have important practical significance for the course

construction and reform work of process equipment and control engineering.

The project team has a reasonable structure and clear division of labor. The project leader and the main team members have rich experience in engineering practice and cooperate with the enterprise, which is conducive to the smooth development of this topic.

The research method of the project is selected appropriately, and it is scientific and operable. The project mainly adopts the method of "cases" as the main line, students as the main body, and teachers as the auxiliary. It follows the guidance of teachers to practice while studying, focusing on solving the case teaching curriculum construction and reform. The project research has strong effectiveness and certain innovation, and has the value and prospect of further promotion in the reform and construction of case teaching courses.

VI. CONCLUSION

The course focuses on "Chemical Engineering Safety Accident Cases". Case analysis is based on student discussions, and is supplemented by teacher analysis, summary, and explanation. It is truly student-centered. On the basis of case teaching, it integrates a variety of teaching methods such as discussion styles. The students' active learning initiative has been greatly improved and achieved good results.

To sum up, this article discusses the new model of case-based teaching method that takes chemical engineering safety accidents as the carrier in the teaching of chemical engineering safety classrooms with the goal of training applied, compound and innovative talents.

- The case-based teaching method adopts a multimedia teaching method to overcome the lack of opportunities for students to encounter actual chemical safety accidents and the difficulties to understand the deficiencies in the teaching content of safety technology in the textbooks. Students learn more safety expertise during the limited classroom hours.
- By collecting chemical engineering safety accident cases and writing case essays, students' self-learning ability has been improved. They have learned the research, retrieval, analysis and synthesis of literature, and have learned the basic requirements and specifications for writing scientific papers. It has greatly enriched the materials of teachers' cases and embodies the main purpose of teaching and learning improving together.
- The number of students actively participating in the teaching process has been greatly improved,

and students' creative ability and ability to solve practical problems have been cultivated. The case teaching method is very suitable for the cultivation of compound innovative talents.

- Case-based teaching puts forward higher requirements for teachers' on-the-spot adaptability, language expression ability, divergent thinking and knowledge. The harmonious relationship between teachers and students and the democratic and harmonious teaching atmosphere are also the key to the success of case-based teaching.

However, the case-based teaching method also has shortcomings. For example, groups should not be too many, and it is only suitable for small classes. The minority students in the group have insufficient participation, and it has the conflict between less hours and heavy teaching tasks. Therefore, the case-based teaching method can only achieve the best teaching effect if it is organically combined with other teaching methods and continuously summarized and improved. Further optimizing and enriching the cases of case-based teaching and promoting the in-depth integration of case-based teaching and traditional teaching methods will be the new direction of chemical engineering safety course teaching efforts.

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