

Research on the Design and Practice of Scaffolding Teaching in Building fire Engineering Course with Professional Direction

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Abstract—In close combination with the current examination outline of registered fire engineers, the teaching design of the Building Fire Engineering course is constructed to cultivate students who are good at learning and innovating, and to improve students' ability to link theory with practice based on the professional-oriented and scaffolding teaching theory. It has a high reference value for the study of engineering curriculum teaching reform under the background of new engineering.

Keywords—Professionalization; Scaffolding teaching; Building fire engineering; Teaching design

I. INTRODUCTION

With the rapid development of the economy and the accelerating urban construction, various functional buildings are emerging one after another. Urban planning cannot keep up with the pace of urban development, fire hazards are gradually increasing, and the incidence of fires in cities and buildings is increasing year by year. Therefore, it is particularly important in the urban construction process as a fire prevention project to prevent and eliminate fires, which puts higher demands on fire engineering talents. And a safety engineering management personnel have been given more and more the responsibility of fire safety, fire engineering design, management and auditing. Training high-quality fire engineering professionals has become one of the important topics to ensure social and economic development.

According to the Ministry of Education issued the "Notice of the Higher Education Department of the Ministry of Education on the development of new engineering research and practice" [1]. The new engineering is summarized as "five new": the new concept of engineering education, the new structure of disciplines, the new model of talent cultivation, the new quality of education and teaching, and the new system of classification development. In recent years, more and more teachers have begun to realize that the traditional "full house irrigation" teaching is not conducive to the cultivation of students' learning ability, and is not conducive to the lifelong development of students. Through reviewing the relevant literature, it is found that the research of "scaffolding teaching" is mostly concentrated in the fields of English, chemistry and physics in the junior high school, and it is less used in the higher education stage, especially in safety science and engineering. The literature in the relevant professional courses in the subject area is rare. Therefore, the application of the

scaffolding teaching in the professional teaching of colleges and universities has great exploration and practical significance. To this end, to re-integrate and optimize the curriculum system and content, and explore the teaching design and practice of the scaffolding construction fire engineering course with the professional orientation of registered fire engineers on the basis of the existing teaching system.

II. CONNOTATION AND CHARACTERISTICS OF SCAFFOLDING TEACHING

The "bracket" was originally intended to be the "scaffolding" used in the construction industry and was a temporary support for the construction of buildings. When the building was built, the support was withdrawn. According to the architectural metaphor, it gradually develops into effective support in the process of learning. To some extent, the metaphor of this image caters to the constructivist learning theory and develops into Scaffolding Teaching Method today [2-3]. The idea of scaffolding comes from the social construction school represented by the famous Soviet psychologist Vygotsky, which is a constructivist teaching method [4-6]. It is believed that all cognitive activities are the result of social interaction. The learning of new knowledge is not only a simple process of absorption and acceptance, but also a process of integrating it into the original knowledge structure [7]. Learners combine their existing learning foundations gradually build a system of cognition of new knowledge through the process of absorption, construction and internalization with the guidance of teachers and the help of partners. Among them, teachers are the guides and promoters of knowledge construction, students are the main body of information processing, and they are the active constructors of true meaning.

III. TEACHING DESIGN PRACTICE OF BUILDING FIRE ENGINEERING COURSE

A. Features of Building Fire Engineering Course

As one of the compulsory professional courses for safety engineering, building fire protection engineering is a comprehensive and practical professional course with multidisciplinary integration. It mainly explores the theory and technology of fire development law, control and fire prevention. Through various teaching links, students are familiar with the system structure and working principle of the building fire

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protection system, master the basic theories and methods for design analysis, installation and commissioning of the building fire protection system, and form certain engineering practice capabilities such as fire protection design and management. To train firefighting and safety professional and technical personnel who can adapt to on-site technical work.

B. Construction of Modular Course System for Building Fire Protection Course with Professional Direction

To construct the course support system, and train students' ability to link theory and practice with the orientation of occupation combine with the current examination outline of registered fire engineer. The building fire engineering course is the main content of the "Fire Safety Technology Practice" in the National Registered Fire Engineer Professional Qualification Examination. The registered fire engineer's examination syllabus is used as the guide to determine the key difficulties of the building fire engineering project and

construct the course unit bracket in the course of teaching. The cultivation concept of "knowledge + skills" is strengthened, and the ability of students to link theory with practice and comprehensively use knowledge is improved, combining the "double-track operation" mode of "real problem + case" practice practice and theoretical teaching.

C. Teaching Design of Building Fire Engineering Course from the Perspective of Scaffold

The scaffolding teaching mode is generally composed of steps such as setting up a teaching scaffold, entering a scaffolding situation, independently exploring research, learning from each other, and evaluating learning effects. The teaching design of building fire engineering course based on the scaffold teaching theory should follow certain principles, as shown in Figure 1. Under this principle, the design of the architectural fire engineering course is carried out. The specific design process is as follows:

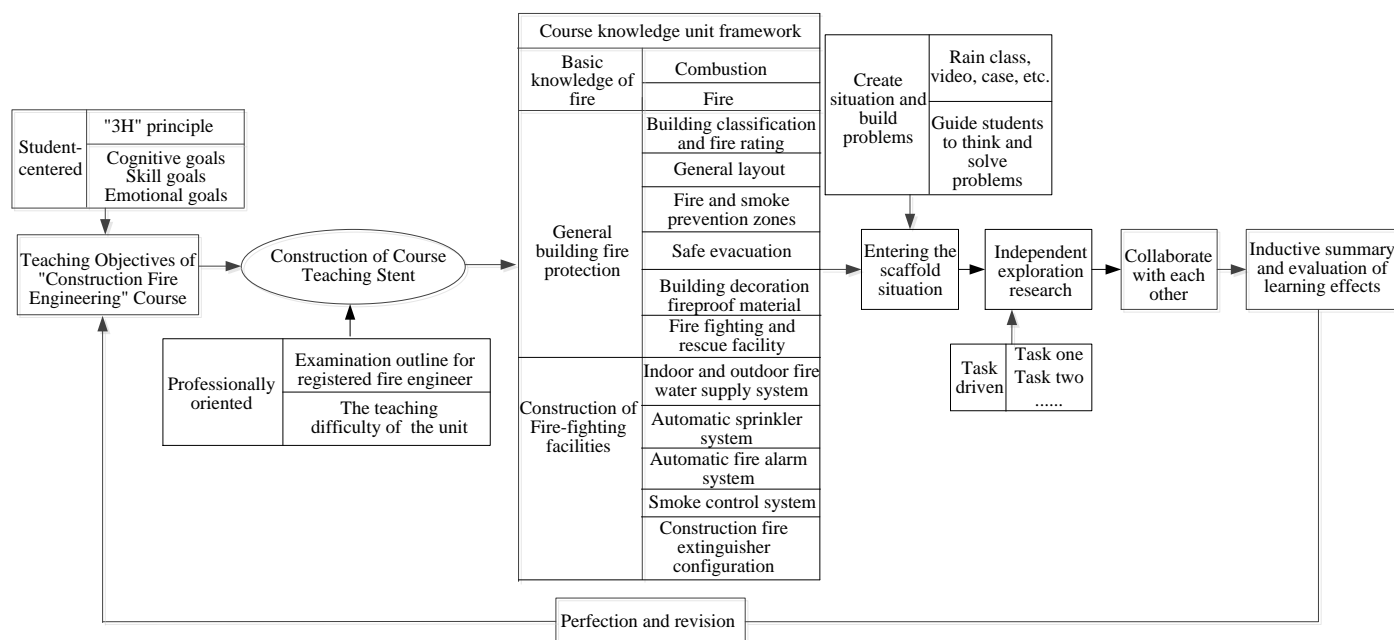


Fig. 1 Teaching design principles for building fire engineering courses

1) Build a fire-fighting course teaching bracket

According to the requirements of the "nearest development zone" theory, the learning support is built around the current learning theme, which is the most basic link in the establishment of the scaffolding teaching mode. The structure of the building fire engineering curriculum system will be adjusted to form the related knowledge module of the basic knowledge of fire, the general building fire prevention and the building fire protection facilities according to the latest development of fire engineering and fire science at home and abroad, and it is closely combined with the society's demand for training talents and the registration of the fire engineer's professional qualification examination syllabus. As a teacher, it is necessary to create a related situational framework to the knowledge module, and the setting of the situation should have a sense of substitution, which can arouse the interest of the

students. At the same time, it must also set a problem framework with certain thinking value and enlightening meaning in the specific context for the knowledge.

2) Guide into the firefighting curriculum situation

Combining current affairs news with case reports to guide students into a conceptual framework node in the situational problem, and to think about the necessary knowledge that should be mastered in a "safe person" role, and to establish a learning framework from easy to difficult problems. The basic content of descriptive and memory is turned into the self-study of students to cultivate students' ability to learn independently.

3) Independent exploration and study of fire fighting issues

Students begin a journey of classroom exploration by creating a situational entry → inspiring questions → seeking knowledge. In the process of exploration, students are mainly engaged in independent exploration, gradually exploring along the support, breaking through one task, and forming their own knowledge system. Teachers should give appropriate guidance when students explore the task of unlocking, but this guiding role should be weakened until the support role of the conceptual framework is gradually removed. Students can independently explore knowledge and state their own understanding of the knowledge module. In this process, teachers should encourage and praise students, and constantly stimulate students' innovative thinking.

4) Collaborative learning of fire fighting courses

A variety of teaching interaction forms such as brainstorming, teaching dating, issue-oriented learning, and fish tank teaching are used in the teaching process through the discussion group divided into 5~8 people, aiming at cultivating the cooperation awareness and communication ability of students. Task-driven is used to allow students to fully participate in the classroom. Students use the online platform to interact with students and teachers, so that they can work together to accomplish tasks better, which is the modern teaching tools, such as rain classes and cloud classes. It is not only helpful for promoting the interaction of learning, stimulating the enthusiasm of learning, improving the participation of students in the classroom, but also fully cultivating the teamwork awareness and communication ability

of students, and achieving the purpose of cultivating emotional goals.

5) Evaluation of the effectiveness of the firefighting course

The evaluation of the learning effect of the scaffolding teaching mode will use the final evaluation combined with the process evaluation based on the evaluation gauge Rubric [8,9], which includes attendance, classroom performance, homework, testing, and group discussion. After each task of the knowledge chapter is released, and a process evaluation is carried out to feedback the staged teaching results to improve the teaching design of the follow-up courses. Research learning outcomes presented in small group presentations uses a combination of self-evaluation and intra-group mutual evaluation in the teaching process. The evaluation grades of the gauges are divided into A, B, C, and D. The evaluation indicators include the attitude of participating activities, the ability to explore, the cooperation exchange, the comprehensive use of knowledge capabilities, and the display of results to form a Rubric score table, which makes the evaluation more comprehensive and objective.

Taking the "configuration of fire extinguisher configuration" knowledge module unit as an example, the scaffold teaching design is carried out, as shown in Table 1. It can be seen that the design of the framework problem is the core part of the unit plan. It determines the scope of the unit learning and guides the students to study and explore a set of questions. The students are placed in a meaningful problem situation, which plays an analysis and an explorer who solves the problem.

TABLE I. SCAFFOLDING TEACHING DESIGN OF BUILDING FIRE ENGINEERING COURSE MODULE

Teaching session	Teaching content		Teaching method
Building teaching scaffolds	Create a situation	Demonstrate typical fire accident cases; Draw out the importance of building fire protection design; Showcase common fire extinguishers around.	Demonstration
	Fundamental issue	Can you use the fire extinguisher around you in case of fire?	Heuristic
	Unit problem	a. How do you save an electrical fire in your life, a fire in a pan? What type of fire extinguisher is used? b. Can fire extinguishers be used to extinguish fires of different fire types? c. What types of fire extinguishers are classified and suitable for the type of fire? How to choose correctly? d. How many fire extinguishers are reasonable in a building?	Heuristic
Entering the scaffold situation	Bring students into a set problem situation, guide students to think and solve problems, and use relevant information to make initial thoughts on the problem.		Lecture and discussion
Independent exploration research	According to the specific building, the fire extinguisher configuration calculation is carried out to consolidate students' in-depth understanding of knowledge.		Task-driven
Collaborating with each other	Practice the use of fire extinguishers and master the essentials of action.		Demonstration
Evaluating learning effects	Knowledge summary and in-depth understanding of the scope and configuration process of fire extinguishers.		Induction

The scaffolding teaching is introduced into the building fire engineering course. The students are the center of the teaching activities, and the teachers are the organizers, guides, helpers and promoters of the teaching activities. Students climb up along the support, correctly combine and apply the relevant knowledge in a specific problem situation, and finally remove the support to guide the teaching by guiding, so that students can master, construct and internalize the knowledge and skills. Also they can learn and use the knowledge in practical training

and enable this ability can be continuously developed, so that they can carry out higher levels of cognitive activities, and truly ensure that teaching is ahead of development, and eventually promote the development of students' thinking. Students can flexibly use the "learned" and "just learned" links in practice.

IV. DIFFICULTIES AND CHALLENGES OF SCAFFOLDING TEACHING IN CONSTRUCTION FIRE PROTECTION ENGINEERING

It is found that there are certain difficulties and challenges in the application of scaffolding teaching through the practice of scaffolding teaching design for building fire engineering courses.

From the perspective of teachers, it is necessary to carefully design the teaching support of each teaching unit, the problem situation, etc.; And the discussion-style classroom teaching progress is difficult to control, requiring teachers to have solid professional knowledge and rich teaching experience in order to make the teaching smoothly and control the teaching progress; The procedural evaluation of the effect requires the teacher to participate in the discussion of each part of the student and form a reasonable evaluation score, which undoubtedly increases the workload of the teacher's classroom preparation.

From the perspective of students, it is necessary to continue to climb along the learning support set up by teachers, increasing the amount of learning tasks, while the enthusiasm for learning to maintain autonomy will gradually decrease. This requires teachers to continuously innovate teaching design, change the form of teaching, and strengthen Incentive effect, fully mobilize the initiative and creativity of students' learning.

V. CONCLUSION

This paper puts forward a scaffold teaching system which is suitable for the construction fire engineering of safety engineering based on the professionalism and the theory of scaffolding through systematic theoretical research and empirical analysis.

The application of the scaffolding teaching model based on constructivism theory in the construction fire engineering course has changed the traditional form of cramming teaching. It is no longer a "teacher speaking, student listening", which makes the student's subjectivity lack, but turned into a "student-centered" teaching model. By constructing brackets to guide students to climb up, it brings students a sense of freshness in the classroom, adds a sense of learning, stimulates the desire for knowledge, who are able to correctly combine and apply the relevant knowledge in a specific problem situation, and

flexibly combine the "learned" and "study" links to form a good classroom atmosphere, which promotes the development of students' thinking and achieves a good learning result.

(1) Under the background of the new engineering department, a scaffold system for building fire engineering courses is constructed based on the examination outline of registered fire engineers, and the professionalization is directed to train students' comprehensive practical ability.

(2) This project proposes a teaching design for building fire engineering based on scaffold teaching, emphasizing that students are the main body of cognition. Teachers provide a simulated situation and guide students to correctly combine and apply the relevant knowledge in a specific situation. It promotes the development of students' creative thinking.

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