

RESEARCH ON THE TEACHING MODE OF "INTRODUCTION TO CIVIL ENGINEERING" AND "FOUR DEGREES, FOUR PROPERTIES AND SIX COMBINATIONS"

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Abstract : "Introduction to Civil Engineering" is an introductory compulsory course for majors in civil engineering. A deep understanding of how to approach civil engineering "why study - study what - study". However, with the development of science and technology and society, the teaching mode of the "Introduction to Civil Engineering" course is gradually out of touch. Starting from the reconstruction of the positioning function of the course, through in-depth analysis of the content of the course, combined with the teaching practice and research of the course, the "Civil Engineering The teaching mode of "Introduction" and "Four Degrees, Four Natures and Six Combinations" has achieved good teaching results.

Keywords: Introduction to civil engineering; Four degrees, Four properties and six combinations; Teaching mode

1 INTRODUCTION

As a major with a good employment situation for many years, civil engineering has become an ideal choice for many students to fill in the college entrance examination. "Introduction to Civil Engineering" is an introductory compulsory course for civil engineering majors. It is responsible for leading students who are completely laymen into the civil engineering industry, enabling students to understand and love civil engineering, and guiding students to initially master the learning methods of civil engineering courses. Mission [1], its teaching goal is to guide students to deeply understand how to deal with civil engineering "why learn - what to learn - how to learn" [2].

2 EXPERIENCE THE "FOUR DEGREES" AND RECONSTRUCT THE POSITIONING ROLE OF THE "INTRODUCTION TO CIVIL ENGINEERING" COURSE

2.1 Experiencing the Temperature—to Fully Understand The Historical Role of Civil Engineering, and to Stimulate Students' Pride in Studying Civil Engineering

Since the beginning of human activities, there have been civil engineering projects, which were mainly used to shelter humans from the wind and rain in the early days. For example, the Yangshao Cultural Site in the Neolithic Age in my country and the Banpo Village Site in Xi'an, etc., have found traces of early houses through archaeological excavations; With the expansion of scope, numerous civil engineering plays a pivotal role in different historical periods. For example, the Great Wall, which was built on the dangerous terrain, has been expanded by several dynasties. In the Ming Dynasty, it formed a great project starting from the Yalu River in the east and reaching Jiayuguan in the west. It stretches for more than 8,850 kilometers. Symbol of spirit and will.

2.2 Experiential Breadth - Comprehensively Understand the Relevant Branches of Civil Engineering, and Improve Students' Initiative in Learning Civil Engineering

Civil engineering has different definitions from different angles [3], and it can be summarized as follows: one refers to the objects of engineering construction, including houses, roads and bridges, ports, etc.; the other refers to a series of technical activities for the construction of engineering facilities, including survey, design, construction, etc.; the third refers to disciplines and majors. In the "Catalogue of Disciplines and Majors Conferring Doctoral and Master's Degrees and Training Postgraduates" promulgated by the Academic Degrees Committee of the State Council, civil engineering and hydraulic engineering are both first-level disciplines. , Architecture, etc. are paralleled, and there are six secondary disciplines under it, including geotechnical engineering, structural engineering, disaster prevention and mitigation engineering and protection engineering, bridge and tunnel engineering; according to the "Catalogue of Undergraduate Majors in Ordinary Colleges and Universities" promulgated by the Ministry of Education in 2020, The undergraduate major of civil engineering belongs to the civil engineering major of the engineering category, the code is 081001, and it is juxtaposed with the majors of architectural environment and energy application engineering, water supply and drainage science and engineering, building electrical and intelligentization.

Civil engineering has different technical fields in different periods, and the professional scope is also not consistent. In 1998, the Ministry of Education adjusted the professional catalog and merged eight majors including mine construction, construction engineering, and civil engineering into the civil engineering major. After years of evolution, today's civil engineering has developed many branches, such as construction engineering, bridge engineering, water conservancy engineering, track engineering, etc., including structural engineering, rock engineering, etc.

Civil engineering, engineering cost and other professional directions. The vast branches and professional directions provide civil engineering graduates with a wide choice of positions and employment directions, and provide abundant

employment opportunities for students with different personalities and interests who also love civil engineering. Freshman entering college brings anxiety and confusion.

2.3 Depth of Experience - Comprehensively Understand the Ability Requirements of Civil Engineering, and Improve the Pertinence of Students Studying Civil Engineering

Although there are many branches of civil engineering majors, and there are great differences in employment positions, there are basically some common requirements for the ability of civil engineers; with the development of society, modern civil engineering projects are becoming more and more complex, and high-tech applications are becoming more and more extensive. And the ability to become the basic requirements of civil engineers.

The Body of Knowledge (BOK, Body of Knowledge) Committee of the American Society of Civil Engineers (ASCE) evaluated the requirements of civil engineers from three dimensions: knowledge, skills, and attitudes, and summarized 24 industry-recognized standards. This includes professional attitude. Because the work of civil engineers is closely related to human life, the seeds of responsibility awareness should be planted in the hearts of freshmen as soon as possible, so that students realize that civil engineering participants need to be responsible for life, and always remember that responsibility is heavier than Mount Tai. ;Civil engineers should have self-learning ability. Schools should strengthen students' self-learning ability and turn passive learning into active learning, so that they can become excellent engineers who can discover and solve problems in the future; It is not a simple single problem, but a collection of problems, which requires students to make comprehensive use of the knowledge they have learned; coordination and management skills are equally important, and the construction of a civil engineering cannot be separated from the close cooperation of all relevant links, so it is necessary In addition to learning textbook knowledge, students are guided to exercise their comprehensive abilities by actively participating in various activities inside and outside the school, learn to carry forward team spirit, and complete projects through division of labor and cooperation, thereby improving coordination and management capabilities.

2.4 Difficulty of Experience - A Comprehensive Understanding of the Curriculum of Civil Engineering, Focusing on the Effectiveness of Students Studying Civil Engineering

There are many fields in the civil engineering industry, and the nature of the work varies greatly. Students have a wide range of employment opportunities. They can engage in different jobs such as design, construction, and supervision in different industries such as housing construction, roads and bridges, railways, and municipal administration. As a student, it is impossible to complete courses in all directions of civil engineering at the university level, and the curriculum system is the key to cultivating students to meet their social ability needs. Therefore, it is necessary to give a brief explanation of the curriculum of civil engineering majors, so that students can have a relatively clear understanding of the curriculum of each professional direction of civil engineering, and have a basic concept of the relative relationship of the courses offered, so that students can have a clear understanding of the curriculum.

Understand the function and difficulty of each course in detail, so as to choose courses according to your own interests and hobbies, and improve the effectiveness of learning.

Generally, the curriculum system of civil engineering major is divided into theoretical knowledge teaching and practical teaching system. The theoretical knowledge teaching system includes humanities and social sciences, instrumental, natural science and professional knowledge; among them, professional knowledge refers to the basic methods and theories required for civil engineering design, construction, management, etc., including the basic principles of mechanics, Surveying, drawing, materials and other technical foundations, engineering project economics and management, basic principles of structural design, construction principles and methods, and the application of computers in civil engineering. The practical teaching system includes experiments, practice, design, social practice and scientific research training. According to this classification method, it is easy for students to understand that practical courses are an important part of the civil engineering curriculum system, and theory can only be transformed into their own professional ability through practice, thus guiding students to pay attention to the important role of practice.

In order to help students adapt to the university learning mode as soon as possible, the main professional basic courses and professional courses of civil engineering undergraduates can also be divided into four types according to research methods [4]: basic theory, applied theory, engineering practice and management. Basic theory courses, such as various "mathematics" and "theoretical mechanics" courses, start from basic assumptions or laws (axioms), take "definition + theorem + application examples" as the basic structure, and require logical and rigorous thinking; application theory These courses include "Engineering Materials", "Soil Mechanics", "Engineering Geology", "Principles of Reinforced Concrete" and "Principles of Steel Structures". The induction of practical engineering experience does not deliberately pursue logical rigor, but takes application as the main purpose.

3 GRASP THE "FOUR NATURES" AND PROMOTE THE SELECTION AND DEVELOPMENT OF COURSE CONTENT

3.1 Interesting—Creating a Situation for Historical Allusions

Confucius said: "Those who know are not as good as those who are good, and those who are good are not as good as those who are happy." That is, interest is the best teacher. The main means to make students interested in the course is to show the interest of the course, and the historical allusions and many other contents in the introduction course are an inexhaustible source of interest.

For example, when talking about modern civil engineering, you can introduce the landmark structure - the Eiffel Tower, and introduce its tortuous process from preparation, plan establishment to successful construction. To commemorate the 100th anniversary of the victory of the French Revolution, the French government invited construction bids to the public. At the beginning of the bidding, Eiffel himself was busy with the affairs of the metal railway bridge, so he entrusted the bidding to his subordinates. He was not optimistic about the ideas of the two young people in the company. Scheme - Iron Tower. Unexpectedly, the scheme stood out among more than 700 bidding schemes submitted and was selected by the jury in one fell swoop. Eiffel exchanged 1% of the project fee for the authorship of the two young people's ideas, and the subsequent designs were designed and signed by Eiffel. During the construction process, the Eiffel Tower was criticized due to its unusual appearance at the time, and the Eiffel Tower was finally built after hardships. Today, the Eiffel Tower has become a landmark building in Paris and even France.

3.2 Characteristic—Teaching Three Professional Directions

The content of civil engineering is vast, and one of the difficulties faced by the "Introduction to Civil Engineering" course is how to choose materials and properly play the role of this introductory course. If only one professional direction is taught, it is against the trend of the times of major civil engineering; and limited to the limited hours of the "Introduction to Civil Engineering" course, it is impossible and unnecessary to introduce the content of all professional directions of civil engineering in detail.

Considering the practical needs of the diversion mode for senior grades, we try our best to introduce the whole picture of several professional directions that can show the professional characteristics of the school (our school chooses three directions of construction engineering, bridge engineering, and geotechnical engineering) in the introductory course. Others It is left to the students to study on their own. In this way, when students choose majors in senior grades, they will have a more comprehensive and systematic understanding of the basic content, nature, characteristics, and even the research level of the school, so that they can choose the majors they really like.

In the specific teaching, the engineering facilities in the professional direction are used as the bright lines, and the infrastructure procedures such as planning, survey, design and construction are used as the hidden lines, and the hidden lines are integrated into the engineering facilities for explanation. For example, when describing the construction engineering module, first briefly introduce the classification of buildings according to the purpose, the materials used in the main structure, the number of floors, and the structural system, and point out the significance of these different classifications; then focus on the spatial structure and the structure of high-rise buildings. The courses are organized in terms of system classification; finally, specific high-rise buildings with shear wall or cylinder structure are selected, and the planning, survey, design and construction of the building are introduced in detail from the perspective of hidden lines.

3.3 Systematic - Take the Knowledge System As the Main Line

The so-called knowledge system refers to a collection of relatively comprehensive and complete knowledge. The curriculum system is not equal to the knowledge system. On the one hand, some important content in a certain knowledge system may not be included in the courses offered at the undergraduate level; on the other hand, some contents belonging to different knowledge systems may be included. are programmed into the same course.

When making teaching arrangements for undergraduate courses, the main considerations are the cohesion of courses and the inappropriate concentration of class hours in the same semester. Due to the limitation of class hours, credits and students' elective content, the courses that students study at the undergraduate stage are only part of the curriculum system, and there is still a certain lack of knowledge system.

A relatively complete overall framework of the knowledge system has not yet been established, so it is not advisable to only introduce the content to be learned in the order in which the courses are started. For example, taking the knowledge system as the main line and taking into account the curriculum system to introduce the learning content, so that students can know what they are learning, the relationship between the content and other content, and what content needs further study, which is conducive to promoting students' learning initiative.

3.4 Generality - Outline and Guide the Follow-Up Courses

Most of the main content involved in the "Introduction to Civil Engineering" course will be described in detail in the subsequent courses. How to deal with the "overview" of the introduction course is the key to the success of this course. The course of "Introduction to Civil Engineering" should not be superseded by others, and involve too many details of the follow-up courses, nor should it be generalized, careless, and empty. In teaching, we should focus on instructing students how to view civil engineering "why learn - what to learn - how to learn". "Why to learn" focuses on the historical role of civil engineering and its important role in the national economy; "What to learn" focuses on the main professional direction of civil engineering, industry conditions, civil engineers' ability requirements and knowledge structure, etc.; "How to learn" Focus on discussing the characteristics of the civil engineering curriculum system and suggestions for university study and life.

4 IMPLEMENT THE "SIX COMBINATIONS" AND ENRICH THE TEACHING METHODS OF THE INTRODUCTION COURSE

4.1 Combination of Professionalism and Ideology

The development of civil engineering runs through ancient and modern times. It is a living fossil that reflects the development of social economy, culture, science and technology in different historical periods. Many projects have an exciting historical story behind them.

Such as the ingenious conception of the breathtaking Dujiangyan project. The area around Dujiangyan in Chengdu, Sichuan is right on the path where the Minjiang River flows from the mountainous area in the northwest through the Chengdu Plain to the Yangtze River in the south. The water flows very quickly in the mountains, and when it reaches the plains, the flow speed suddenly decreases, and the sediment carried in the water is deposited along with it, which is easy to block the river. Therefore, every year in summer, the water potential of the Minjiang River rises sharply, and floods often occur, which have not been successfully treated for a long time. After Li Bing served as the governor of Shu, he carefully inspected the terrain around Dujiangyan, learned from the experience of predecessors in river management, and found the key to the flooding of the Minjiang River; together with his son, he led the local people, overcame various difficulties, and adopted ingenious methods of flood control and water control, and finally completed the project. This world-famous water conservancy project - Dujiangyan. This project is the largest and most successful grand water conservancy project in ancient my country, which is the oldest and only surviving in the world, and is characterized by water diversion without dams. It is a monument in the history of ancient Chinese science and technology.

Another example is the Qiantang River Bridge with ill-fated fate. Due to the complex geological conditions at the bottom of the Qiantang River, foreign experts at that time believed that "the Qiantang River is deep and fast, and it is impossible to build a bridge.

The famous bridge scientist Mao Yisheng and other builders selected the appropriate bridge site through arduous surveys and creatively used the air pressure method to excavate mud and piles, the caisson method to build bridge piers, and the floating method to erect steel girders, and finally succeeded in 1937. The Qiantang River Bridge was completed. However, the fate of the Qiantang River Bridge was ill-fated. During the War of Resistance Against Japan and the War of Liberation, it was bombed and repaired several times. It was reinforced and reopened to traffic in April 1954. It has been in use until now.

In the classroom teaching, appropriately citing famous engineering cases and historical figures in the field of civil engineering and other ideological and political education themes, and educating students on humanistic quality and patriotism can enable students to understand the development of civil engineering more comprehensively while learning professional knowledge. It will have an extremely important impact on stimulating students' enthusiasm for learning, strengthening their ideals and beliefs and "four self-confidence", enhancing their sense of responsibility, and establishing a correct professional outlook and outlook on life.

4.2 The Combination of Multimedia and Network Teaching

The courses of "Introduction to Civil Engineering" involve construction engineering, bridge engineering, road engineering and other professional directions, which are closely integrated with practical engineering problems. It contains a large amount of content, even for those who have been in the field for many years but have no contact with this field. It is also relatively unfamiliar, not to mention for students who have just studied civil engineering. The multimedia courseware has the characteristics of vivid images and dense information. In classroom teaching, the advantages of multimedia teaching can be fully utilized. The intuitive feeling of the students can also allow students to understand the advanced construction methods and construction technologies of some major projects at home and abroad without leaving home. For example, when explaining the construction of the shield method, many students have no idea about it. Videos such as the construction of subway tunnels enable students to vividly understand the continuous construction steps of the shield machine "initiation-advancement-slag discharge-segment assembly, etc."; internal structure to show more abstract construction techniques, processes, etc., such as reverse construction steps.

4.3 Combining Theory With Cases and Practice

Civil engineering is closely related to human's basic necessities of life, and is a highly practical profession. Therefore, it is advisable to combine it with engineering cases when teaching the relevant theories of the introductory course, so as to improve students' perceptual knowledge. On the one hand, it is possible to select engineering examples that students often come into contact with in their daily lives, such as teaching buildings for classes, gymnasiums for sports, etc., to introduce the structural forms and design principles of various buildings with different functions, so that students can deeply understand the characteristics of daily life. Closely related to civil engineering, while shortening the physical distance between students and civil engineering, it also shortens the emotional distance between the two, and encourages students to pay more attention to the surrounding civil engineering in the future. on the other hand,

It can also introduce some famous civil engineering projects at home and abroad, such as Shanghai Center, Bird's Nest, National Center for the Performing Arts and other famous buildings, Hong Kong-Zhuhai-Macao Bridge, San Francisco Golden Gate Bridge and other Chinese and foreign famous bridges. This can not only broaden the knowledge of students, but also enable students to understand the latest developments in civil engineering at home and abroad.

In addition, students can be arranged to visit the typical projects that have been completed, representative projects under construction, and laboratories in the school. In particular, some special topics for practical activities can be arranged, such as investigating ancient buildings such as dwellings, and combining them with subject competitions to build Architectural structure models, etc., enhance students' cognition of the majors they study, improve students' learning interest, build up their learning confidence, and help students establish correct labor concepts and cultivate a down-to-earth work style,

which helps to cultivate students' collectivism and The spirit of unity and cooperation, the rigorous and serious scientific spirit and the scientific attitude of seeking truth and being pragmatic will lay the foundation for future work.

4.4 Combination of Basic Knowledge and Hot issues

The basic knowledge is mainly the main professional direction of civil engineering, the industry situation, the ability requirements and knowledge structure of civil engineers introduced in "What to learn", which is the main body of the "Introduction to Civil Engineering" course; Construction, BIM, 3D printing and other industry development trends and the latest personal research results of teachers, can also include landmark civil engineering facilities under construction, recent natural disasters and engineering accidents, etc., can be lectured on special topics, but more often It is interspersed in the process of teaching basic knowledge. Lectures on hot issues can promote students to expand their knowledge, broaden their horizons, learn basic knowledge, lay a good theoretical foundation, and enhance students' sense of urgency in learning, especially the lectures on engineering accidents can also cultivate students' awareness of safety responsibility and rigorous engineering views .

4.5 Combination of Heuristic, Paired Classroom and Project Teaching

In the course teaching, we can give full play to the advantages of civil engineering teaching materials at your fingertips. According to the content taught, examples of civil engineering around you are used to inspire and interactively teach students. For example, when teaching beams, slabs, columns, and wall components that are common in building construction, students can observe their classrooms and inspire them. Think about the path of load transfer in building construction, and then give targeted comments and explanations based on the students' answers, so that students can quickly understand the concept of basic structures and master the basic principles of load transfer. When teaching bridges, housing construction and other basic and common-sense engineering facilities, you can also try to use paired classrooms to promote students' active learning, equal exchanges, and bold questions; in order to avoid group discussions.

If the topic is too scattered or you don't care about the topics discussed by other groups, you can use the project teaching method. For the same project, different groups work together from different perspectives such as design, construction, and materials, and study and discuss in depth. Through this inspirational and interactive teaching method, not only can the teaching effect be significantly improved, but also the students' independent thinking and cooperation ability can be cultivated, and the enthusiasm and initiative of the students can be greatly stimulated.

4.6 Combination of Team Teaching and Assessment

The course of "Introduction to Civil Engineering" has many branches, wide scope, and miscellaneous content. Due to the limitations of knowledge structure and research field of a single teacher, it is often difficult to cover everything. It is a powerful means to ensure the teaching effect of this course by establishing a teaching team that not only has expertise in its own research field, but also can jointly study teaching content and methods, as well as core members who are relatively stable and cooperate with each other. Carry out lectures and other methods to form dynamic teaching resources and enrich the connotation of the teaching team.

The quality of teaching is the foundation of running a university, and the examination is the most basic and important means to test the quality of teaching, and it is also an important part of course teaching. In order to change the disadvantages of the traditional assessment form, according to the characteristics of the "Introduction to Civil Engineering" course, the total assessment score of this course is divided into three parts: offline score, online score and final examination score. Offline grades are mainly based on the assessment of basic course knowledge, including attendance, daily homework, classroom exchanges, subject competitions, etc.; online grades are mainly based on optional content assessment, including extended learning, online homework, etc.; Examination is the main

The forms are diverse and the content is rich, including the understanding of various professional branches, one's own professional interests, future career planning and harvest, etc. Adopting a comprehensive evaluation method has improved the bad cycle of "teaching for exams and learning for scores" and team teaching tends to focus too much. Transfer students from "passive exams" to "active exams" to promote students' interest The effect of conscious and active learning.

5 CONCLUSION

This paper starts with the reconstruction of the positioning function of the "Introduction to Civil Engineering" course, through in-depth analysis of the content of the "Introduction to Civil Engineering" course, combined with the specific development of science and technology and social situation, puts forward the "Introduction to Civil Engineering" "four degrees, four characteristics and six combined" teaching mode. This teaching mode has achieved good teaching effects in promoting students' understanding and love of civil engineering, stimulating learning interest, and instructing students to deeply understand how to deal with civil engineering "why learn-what to learn-how to learn", and can be applied to the application-oriented The curriculum reform of undergraduate colleges and universities plays a constructive reference role.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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