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Research on Teaching Reform of Landscape Engineering Course based on the Concept of CDIO

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Abstract: With the advancement of new engineering construction, it is urgent to explore the teaching reform of professional courses in the cultivation of landscape architecture professionals in combination with industry needs. In order to solve the problems existing in the current Landscape Engineering course, such as traditional teaching methods, insufficient student interest, lack of practical links, and the disconnection between teaching content and industry demand. This study discusses the teaching reform of the Landscape Engineering course based on the CDIO (Conceive-Design-Implement-Operate) concept, aiming at solving the problems mentioned. Through the integration of CDIO mode, the core competencies that students should have are defined, including environmental landscape design and planning, innovative thinking, project management, and so on. The research emphasizes project-driven learning, interdisciplinary knowledge integration, and practical skill training, and puts forward strategies such as teacher training and professional development support to ensure the implementation of the reform. The purpose of the reform was to improve students' professional ability and employment competitiveness, promote the improvement of education quality and the sustainable development of the industry, and exert a positive impact on landscape engineering education and industry progress.

Keywords: CDIO; Curriculum construction; Teaching reform; Landscape Engineering; Landscape architecture

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1. Introduction

The CDIO (Conceive-Design-Implement-Operate) engineering education model is a recent achievement in the reform of international engineering education. It is a new model of higher engineering education aimed at cultivating senior engineering professionals [1]. To date, dozens of world-renowned universities have joined the CDIO International Organization, and these institutions have achieved good results by adopting the CDIO engineering education philosophy. Moreover, students trained according to the CDIO model are particularly

welcomed by society and businesses [2].

In recent years, Chinese universities have been actively promoting the construction of new engineering disciplines to promote the development of talent cultivation towards practicality and interdisciplinarity. The cultivation of landscape architecture professionals, which is mainly application technology-oriented, should combine the development and diversified needs of the industry to explore the reform of professional courses. Under the cultivation standards and specifications of the CDIO model [3,4], the teaching of landscape engineering courses will be more improved and targeted, while the engineering capabilities of students can also be enhanced.

2. Status quo of Landscape Engineering course teaching

Landscape Engineering is a professional core course offered in the landscape architecture major, mainly involving site engineering, water supply and drainage engineering, green planting engineering, and other contents [5]. The training plan is to enable students to master landscape engineering design while being familiar with related knowledge such as construction principles, construction technology, and construction organization and management. It aims to cultivate students' ability to analyze and solve problems and to better address various technical issues on the construction site.

The Landscape Engineering course has the characteristics of interdisciplinary fields. In the traditional education and teaching model, there is too much emphasis on the teaching of theoretical knowledge. At present, there is a certain lag in the course content, making it difficult to achieve an organic combination of landscape design and construction engineering. Since the theory and practice of landscape engineering are closely integrated, students are required to have certain relevant knowledge before learning. This leads to students having certain problems in understanding and mastering the knowledge content of Landscape Engineering, resulting in an inactive classroom atmosphere and low student autonomy. Especially when it comes to construction content that is less encountered in daily life, such as site engineering and rockery engineering, students' understanding is not ideal. Therefore, the current situation of course teaching is roughly as follows: (1) The limitations of traditional teaching methods. (2) Lack of stimulation of students' interest in learning. (3) Insufficient practice. (4) The teaching content does not match the needs of the industry. These four situations urgently need to be improved.

3. Course design content and application of CDIO

3.1. Application of CDIO concept in course objective design

3.1.1. Defining the core competency requirements of Landscape Engineering courses

The goal of the Landscape Engineering course is to create a beautiful and comfortable living environment through reasonable layout and design, enhancing people's quality of life and sense of happiness. According to industry demands and educational practice, the core competency requirements of the Landscape Engineering course need to consider the professional characteristics and occupational needs of the field and should include the following aspects:

(1) Environmental landscape design and planning skills: Students need to have the ability to comprehensively analyze and evaluate environmental landscapes, considering from ecological, cultural, social, and other perspectives, and plan and design according to different needs and objectives, including site analysis, conceptual design, and detailed design.

(2) Innovative thinking and expression skills: Students need to have innovative thinking and design expression skills, able to use design principles and technical means to integrate various information to provide creative design plans and solutions, creating landscape works that meet people's needs and aesthetics.

(3) Project management and coordination skills: Students should understand the basic principles and methods of project management, have project management and team collaboration skills, and can effectively organize and manage the implementation process of landscape projects, organize resources effectively, coordinate the interests of all parties, and ensure the successful completion of the project.

(4) Technical application and engineering practical skills: Students should be familiar with the relevant techniques and processes of landscape engineering, understand the construction process, and be able to reasonably apply knowledge and skills in green plant material selection, construction technology, and material application to solve practical problems.

(5) Ecological environment and sustainable development awareness: Students should understand the principles of the ecosystem, have environmental ethics and sustainable development awareness, and focus on environmental protection and resource conservation in the design and implementation process to achieve sustainable development as much as possible.

The above are the general requirements for the core competencies of the Landscape Engineering course. By clarifying the core competency requirements and strengthening teaching and practical training, the comprehensive ability and employability of students can be improved.

3.1.2. The fit between CDIO philosophy and Landscape Engineering course objectives

In the process of cultivating landscape engineering professionals, the CDIO educational philosophy provides a feasible method and framework to cultivate professionals with comprehensive skills, which fits well with the core competency requirements of the landscape engineering course.

Firstly, the "Conceive" in the CDIO philosophy fits well with the "Innovative Thinking and Expression Skills" in the Landscape Engineering course objectives. Students majoring in landscape engineering should have innovative thinking and creativity, able to propose novel landscape design plans and solutions and effectively express and display them. Secondly, the "Design" in the CDIO philosophy fits well with the "Environmental Landscape Design and Planning Skills" in the Landscape Engineering course objectives. Students majoring in landscape engineering need to have comprehensive planning and design capabilities, including landscape planning, plant configuration, material selection, etc. and can consider its feasibility and adaptability from a holistic perspective. Then, the "Implement" in the CDIO philosophy fits well with the "Project Management and Coordination Skills" in the Landscape Engineering course objectives. Students majoring in landscape engineering need to have the ability to manage and coordinate the implementation process of the project, able to transform the design plan into actual engineering, and ensure the smooth progress of the project. Lastly, the "Operate" in the CDIO philosophy fits well with the "Technical Application and Engineering Practical Skills" and "Ecological Environment and Sustainable Development Awareness" in the Landscape Engineering course objectives.

Therefore, the CDIO educational philosophy has a close fit with the Landscape Engineering course objectives. Through project-driven learning, design practice, practical operation, and teamwork, it can gradually cultivate students' environmental landscape design and planning skills, innovative thinking and

expression skills, project management and coordination skills, technical application and engineering practical skills, and ecological environment and sustainable development awareness.

3.2. Application of CDIO philosophy in course content design

3.2.1. Developing project-based learning tasks

The CDIO theory emphasizes the cultivation of interdisciplinary comprehensive skills and practical application skills in students during the learning process. In landscape engineering projects, applying CDIO theory to develop learning tasks can help students better understand and apply relevant knowledge and skills. For example, in the implementation phase, students need to carry out specific implementation plans and operational processes. They can be divided into groups, each responsible for a specific task, such as lawn paving and plant selection. Students can conduct field visits, collect the necessary materials and tools, organize the construction process, and carry out necessary monitoring and control measures. By developing landscape engineering project-based learning tasks based on CDIO theory, students can comprehensively develop their overall abilities and practical application skills. At the same time, the teaching process can even introduce industry experts, organize field visits and industry internships, and evaluate the results and effectiveness of the project with students. Through project practice, students can better understand and apply relevant knowledge and skills and be competitive in their future career development.

3.2.2. Introducing interdisciplinary knowledge and practical expansion

The CDIO philosophy advocates the interdisciplinary integration of knowledge and skills in the course. In the field of landscape engineering, designers need to master not only natural science knowledge such as botany and soil science but also social science knowledge such as urban planning and environmental psychology, as well as technical skills such as art design and computer-aided design (CAD). This interdisciplinary knowledge system provides a rich perspective and methodology for landscape engineering, making landscape design not only the beautification of natural space but also an exploration of the harmonious coexistence of human activities and the natural environment. Practice is the core of landscape engineering education in course content design. Schools should cooperate with local governments, non-governmental organizations, and private enterprises to provide students with the opportunity to participate in actual projects. For example, students can participate in green space planning in urban renewal projects or engage in ecological restoration work in nature reserves. These practical experiences not only train students' technical skills but also cultivate their team collaboration and communication skills. At the same time, by participating in international competitions and exchange programs, students can broaden their horizons and understand the latest trends in global landscape engineering. With the development of information technology, many new technologies have emerged in the field of landscape engineering, such as Geographic Information Systems (GIS), Building Information Modeling (BIM), and Virtual Reality (VR). These technologies provide new tools and perspectives for landscape design. The course should introduce these technologies to enable students to understand and master how to use them for increased efficiency.

The educational model of the Landscape Engineering course should pay attention to the integration of interdisciplinary knowledge and the cultivation of practical skills. By integrating natural science, social science, art design, and technical skills, and combining practical projects and technical tools, students can constantly improve their professional quality in the process of solving practical problems.

3.2.3. Designing the course content with engineering practical significance

To design the course content of landscape engineering with engineering practical significance, it is necessary to combine theoretical knowledge with practical operation to ensure that students can apply what they have learned in real or simulated environments and solve practical problems. Through the curriculum design shown in **Figure 1**, students can not only gain solid theoretical knowledge but also exercise their engineering skills in practice, laying a solid foundation for their future careers. At the same time, this educational model is also helpful to cultivate students' innovative spirit and ability to solve practical problems.

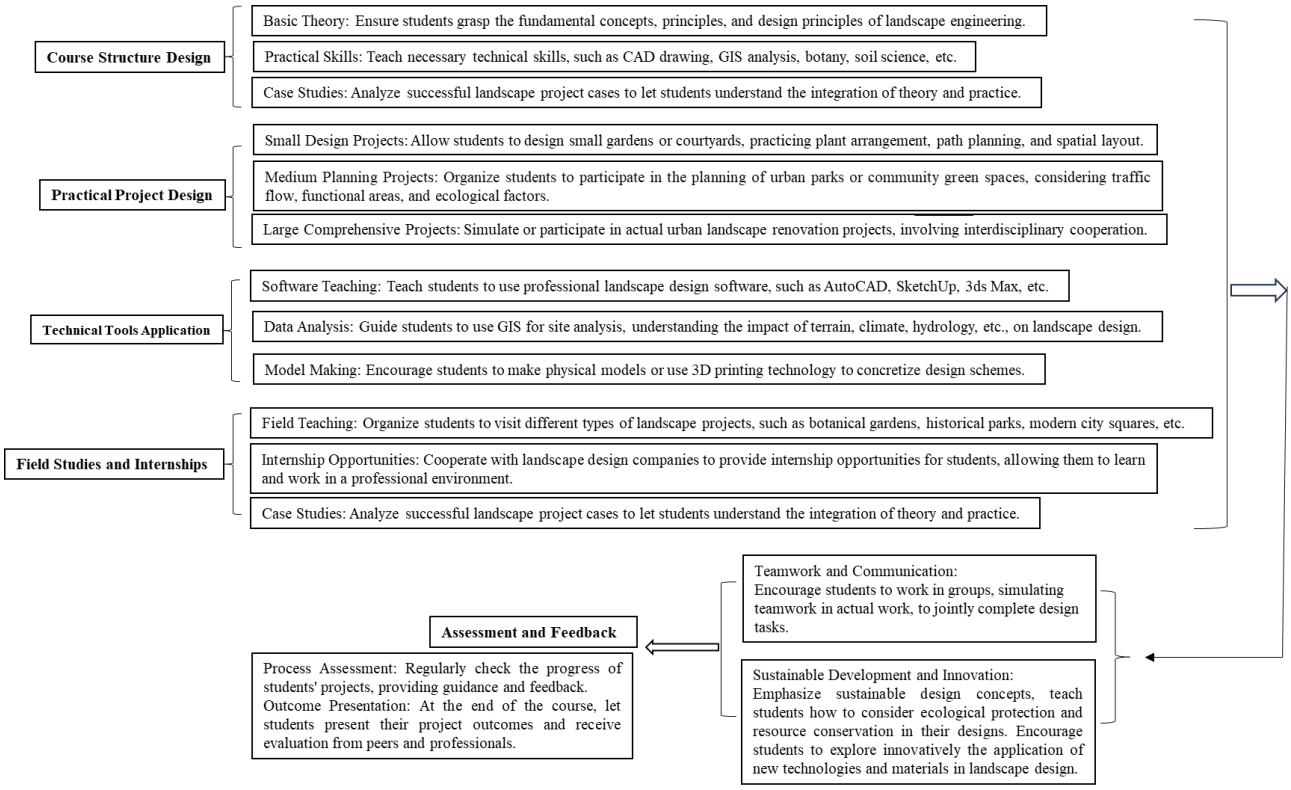

Figure 1. Schematic diagram of Landscape Engineering course design

4. Conclusion

The purpose of the teaching reform of Landscape Engineering courses based on the CDIO concept is to cultivate professionals who meet industry demands, focusing on fostering students' innovative awareness, comprehensive analytical abilities, and practical skills, enabling them to solve problems and face challenges in actual work. In terms of teaching methods, there is an emphasis on integrating theory with practice, as well as training in teaching practical cases and operational exercises to cultivate students' practical operations and hands-on capabilities. Consequently, the CDIO concept positively impacts landscape engineering by enhancing the quality of education, nurturing innovative talents, promoting industry advancement, strengthening international competitiveness, and facilitating the integration of industry, academia, and research. The CDIO concept is anticipated to have a positive influence on the future development of landscape engineering, contributing to the improvement of educational quality, the cultivation of innovative talents, the promotion of industry progress, the enhancement of international competitiveness, and the promotion of the integration of industry, academia, and research.

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