

Exploring the feasibility of teaching case studies in basic courses in engineering colleges in the context of the dual carbon strategy

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Abstract. Under the background of the dual carbon strategy, it is imperative to strengthen the carbon peak and carbon neutral higher education. Based on engineering colleges and universities, this paper explores the feasibility and implementation methods of case teaching for basic courses in engineering colleges and universities, and elaborates the implementation basis, implementation plan and effects of case teaching with the control engineering basic course as an example. Taking into account the current situation and policies as well as the background of talents, funding and hardware of the institution, this highly participative and practical teaching method can effectively cultivate students' ability to solve complex engineering problems, and at the same time play a good role in promoting the cultivation of double carbon talents.

1.Theoretical Background

In the context of the strategy to achieve peak carbon and carbon neutrality, China must change its development mode and carry out an energy revolution. With the goal of achieving "peak carbon and carbon neutrality" in mind, Chinese universities have launched a green campaign. The Ministry of Education has issued the "Action Plan for Carbon Neutral Science and Technology Innovation in Higher Education" and the "Work Plan for Strengthening the Cultivation System of Carbon Neutral Higher Education Talents" in response. This is destined to be an unprecedented scientific and technological "war". The high precision "green technology" results independently developed by universities will provide strong scientific and technological support for national energy security and green low-carbon development. However, the role of "green" is not only in scientific research, but also in systematic and transformative research on basic theories and engineering applications, the training of innovative talents, and the promotion of simple and moderate, green and low-carbon, civilized and healthy lifestyles.

The aim of engineering is to produce workers with practical application skills. The above mentioned mainly refers to traditional engineering disciplines, in addition to new engineering disciplines for emerging industries. The emerging industries and the new economy of the future need highly qualified composite new engineering talents with strong practical ability, strong innovation ability and international competitiveness. Talent cultivation is inseparable from basic teaching, the traditional teaching methods focus on the inculcation of basic theoretical knowledge, individual courses will also set up

experiments and practical links, courses have been more or less reformed after more or less teaching reform, but also have achieved greater or lesser reform results. This was integral to basic teaching and was a staple of universities in the process of curriculum construction and curriculum reform before the promotion of the dual carbon goal. The current curriculum construction is still very much at odds with the teaching requirements of the dual carbon goal, and the teaching of basic courses in universities is in urgent need of reform under the new requirements, but it is not appropriate to over-correct them.

The key tasks to strengthen carbon neutral higher education include strengthening green and low-carbon education and incorporating green and low-carbon concepts into the education and teaching system; creating a high-level science and technology research platform; accelerating the training of scarce talents; promoting the transformation and upgrading of traditional majors; deepening the integration of industry and education to educate people collaboratively; strengthening the construction of a high-level teaching team; and increasing the construction of teaching resources, etc. The mission calls for strengthening the training of talents for wind power, photovoltaic, hydropower and nuclear power. Accelerate the training of talents related to carbon capture, utilization and storage. Accelerate the transformation and upgrading of talent training in key areas such as traditional energy power, electrical, transportation and construction. Focusing on the clean and efficient development and utilisation of primary energy sources, strengthen the training of professionals in coal, oil and gas. Focusing on the efficient conversion of secondary energy, the training of talents in new energy such as heavy-duty gas turbines,

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flexible peaking of thermal power, intelligent power generation, distributed energy and multi-energy complementarity will be strengthened. With a focus on serving the construction of new power systems, the training of electrical talents will be strengthened with features such as intelligence and synthesis. Focusing on promoting electrification and energy saving and consumption reduction in construction and industry, the training of talents in transportation and construction will be strengthened.

2. Case Studies

Case teaching is a new type of open-ended and interactive teaching method. Usually, case teaching has to be carefully planned and prepared in advance, specific cases have to be used and students are instructed to read them in advance, discussions or debates have to be organized to form repeated interactions and exchanges, and case teaching generally has to be combined with certain theories to achieve the purpose of enlightening theories and enlightening thinking through the collision of various information, knowledge, experiences and views. It is mainly used in disciplines such as management, law and medicine. With the demand for dual carbon education, universities need to strengthen the construction efforts and talent training of majors related to emission peak and carbon neutrality, in addition to infiltrating and even formally promoting the dual carbon strategy to students, so that they can learn what they can and use it. Traditional basic teaching is essential and traditional classroom knowledge does not benefit from too much adjustment. How to achieve dual carbon education and what methods to use to penetrate the dual carbon strategy is a major problem in front of the current university dual carbon education, and it is also something that educators and lecturers need to consider carefully. The case study teaching mode can achieve the current purpose of dual carbon education without changing the traditional teaching materials, and through dual carbon cases to implant dual carbon education into the curriculum system. It is very suitable for the reform of double carbon teaching in most engineering courses.

In the author's own school, for example, the compulsory course "Fundamentals of Control Engineering" is a course with sufficient hours, including both theoretical and experimental parts, with room for adjustment according to the teaching schedule, to ensure the expected practical and theoretical complementary effects. In addition, a diverse course team, such as senior engineers with experience in large state-owned enterprises and teachers with extensive teaching experience, all members of the course team have a good working basis in the teaching and application of this course, extending the meaning of the classroom on the basis of traditional lectures, planning to add case studies and integrating the practical experience of double carbon into the classroom, so that the experience between members is complementary and the objectives are the same, and the classroom effect can be doubled.

2.1. Conceptual Model

The Control Engineering Foundation course is a compulsory foundation course, which is indispensable in the training and education of dual carbon talents. Based on the cultivation of talents in the Guangdong-Hong Kong-Macao Greater Bay Area, the course actively follows the national strategic objectives, and uses the popular dual carbon technology key "CCUS" carbon capture, carbon utilisation and storage as the main line of comparison, and it is necessary to carry out teaching research in the acquisition of knowledge, practical application of knowledge, and consolidation and continuation of knowledge. Under the dual carbon objective, the following aspects of the current basic control engineering course need to be improved. For example, the penetration of green concepts is not sufficient; the course content is abstract and difficult to understand, the examples are old, the traditional teaching methods are not effective; the combination of theory and practice is not close, etc.

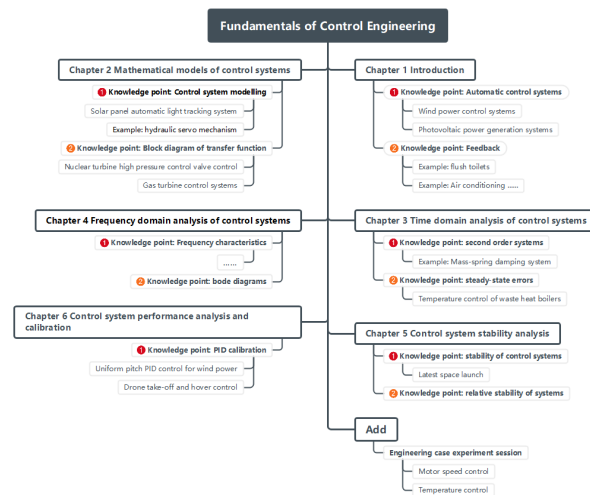


Fig. 1. Basic framework for teaching case studies

To carry out research and exploration for the problems still to be solved in the course can be carried out from the following aspects, first, for the lack of penetration of the concept of green: the course should be taught in the context of the current double carbon objectives, increase the green concept and other thinking and political links in the course of lectures, upgrade the course paradigm, and design suitable cases, through case teaching subtle penetration of the concept of green. Secondly, the course content is abstract and difficult to understand, the paradigm is old, and the traditional teaching method is ineffective: the control engineering fundamentals course is more theoretical and closely linked to basic disciplines such as higher mathematics, plus the course content is abstract and difficult to understand, so it is more difficult for students to learn in the traditional teaching method, and in the double carbon background, the original course paradigm is old, update the old system paradigm, and try to fit in with the key CCUS technology and design. It is imperative to update the old system paradigms and try to adapt them to the key CCUS technologies and design appropriate teaching cases. Once again, the combination of theory and practice is not close: on the basis of the

original classical matlab experiments, the current popular and widely used theoretical and practical aspects are added appropriately, combining classical and popular. In order to achieve the teaching of knowledge at the same time, pay attention to the application of knowledge and interest cultivation, encourage students to practice application after school, so as to achieve the application of learning.

In the context of dual carbon, students today will be part of the implementation of the dual carbon goal. As a course closely linked to the dual-carbon context, teachers have the obligation and need to guide students to understand and enter into the dual-carbon context. After the teaching reform, it is imperative to create a version of a case study course on the fundamentals of control engineering in the context of dual carbon. Combining the teachers' engineering background and practical experience, the basic framework of the case study course on the fundamentals of control engineering is shown in Figure 1. According to the framework and then targeted to carry out the necessary work, satisfactory teaching results can be achieved.

2.2.Method

Control Engineering Fundamentals is a traditional theory course with a wide audience. Focusing on the dual carbon objectives and the key problems to be solved, case teaching can be carried out from theoretical and practical aspects such as.

1) Building a good foundation is the key, control engineering foundation is a compulsory foundation course, any reform should be based on the premise of building a good foundation, learning and teaching the basic theory, and at the same time reforming the service foundation, based on the students' perspective, carrying out student-centred research on learning intentions and learning methods, and adjusting the teaching design according to the research results, designing suitable cases and adding green thinking and politics links to meet the double carbon background, and finally producing A set of effective case study teaching design.

2) Practice is the only criterion for testing the truth, and is also the basis for theory. The original matlab experiment is classic but not enough to cover the theoretical content, adjust the practical link, increase the practical link of engineering application control and improve the practical ratio.

3) Design open and interactive case teaching methods. After careful planning and preparation, use specific cases and instruct students to pre-study them in advance, and organize students to carry out discussions or debates in class, forming repeated interactions and exchanges, so that the collision of students' views can achieve the purpose of enlightening theory and enlightening thinking.

The implementation of case study teaching can be carried out around the 1-2 academic year "Fundamentals of Control Engineering" course, taking a class of students of a certain major as the target of implementation, the implementation plan is shown in Figure 2.

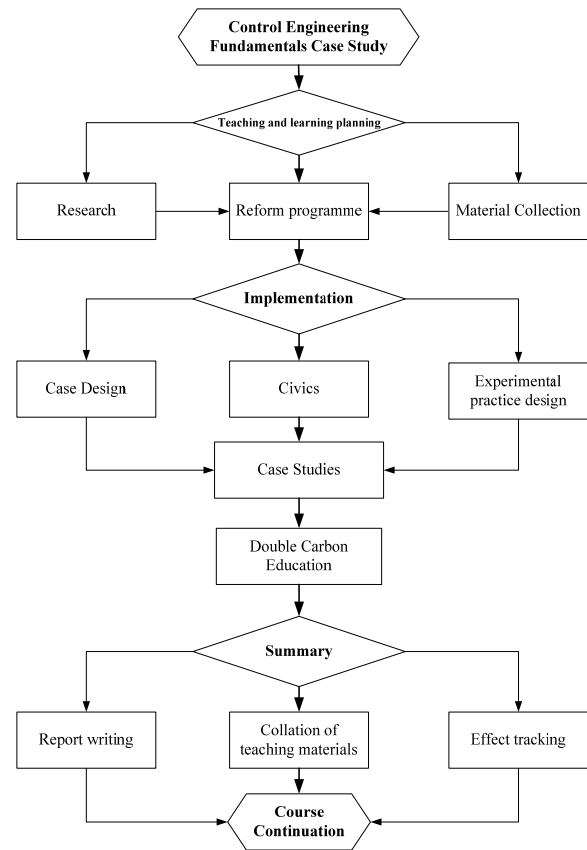


Fig. 2. Case Study Teaching Implementation Plan

Upon completion of the above expected research results, the curriculum system in a dual carbon context will be primed to be effective, with the curriculum closely following the Ministry of Education's Work Plan for Strengthening the Construction of a Carbon Driven, Carbon Neutral Higher Education Talent Training System, serving the dual carbon objective, strengthening green and low carbon education, and infusing green and low carbon concepts into the education and teaching system. The course is designed to be innovative, using case studies to help students understand the course content, updating old system examples and fitting in with key CCUS technologies. Adding current and widely used theoretical and practical sessions, combining the classical with the popular. The course is designed to be exam-oriented, with emphasis on the continuity of the course, the application of knowledge and the cultivation of interest, and the encouragement of practical application after school so that students can put their learning into practice.

This pedagogical exploration is also supported by the current situation and policy, in the context of dual carbon, the state, the province, the city, the school and the college support teaching and learning reforms that are in line with the dual carbon goals. It is also necessary for frontline teachers to respond to the policy call and to keep themselves and their students at the forefront of the times. In most higher engineering institutions, curriculum development usually has a good basis for implementation, such as funding and teaching hardware, as long as the initiative is in line with the objectives of talent training, in terms of project faculty, laboratory equipment, teaching

time, project funding and other aspects can be supported by the school and college. The university has a collaborative education model that focuses on students, adapts to the needs of the industry, and realises the standardisation and internationalisation of professional development; different levels of goal-oriented (extra-curricular practice) and result-oriented (discipline competition) practice and innovation platforms that are driven by the cross-fertilisation of multiple disciplines and professional depth; provincial teaching teams that are highly qualified, professional and well-structured and adapted to professional development, led by excellent teachers; and provincial teaching teams that are led by the Excellence The new teaching model of "active learning, creating an efficient classroom" is implemented to focus on the learning effect of students, and so on. The new teaching model of "active learning, creating a highly effective classroom", focusing on the learning effect of students, etc., has effectively guaranteed the implementation of the curriculum construction.

3.Conclusion

In summary, the case teaching of the "Fundamentals of Control Engineering" course in the context of the dual carbon strategy is in line with the current government policy and education direction requirements, and is reasonable and feasible in terms of implementation basis, implementation content or implementation plan. The implementation teachers can make use of the university's support or apply for educational research projects to develop a pathway for the implementation of case teaching in the basic control engineering course in the context of double carbon. The research results can be extended to other schools and colleges in the same major, the same department, the same college or even other schools and colleges, and the application of the results will certainly promote the teaching effectiveness. The proposed teaching reform methods and the case teaching model can also be borrowed by other courses and extended to the teaching of basic courses in engineering colleges and universities, or even in polytechnics and other disciplines related to the cultivation of double carbon talent. If the results are applied and replicated, the number of students benefited will increase significantly, dual-carbon education will be put into practice and become effective, and the relevant curriculum reform will be renewed.

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