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Construction of Transportation Economics Course Incorporating Carbon Reduction Concept

Huiyun Cao

School of Emergency Management and Safety Engineering, North China University of Science and Technology, Tangshan Hebei, 063210, China

Abstract: The impact of carbon emissions on the environment is becoming increasingly severe. The transportation industry is an important pillar of the national economy and also generates a large amount of carbon emissions. Therefore, it is necessary to provide education on energy conservation and emission reduction to future transportation practitioners in higher education. This article takes "Transportation Economics" as an example to analyze the new approach of curriculum construction based on the concept of carbon reduction in the core courses of transportation majors, and introduces the innovative teaching methods and content of the "Transportation Economics" course based on the concept of carbon reduction.

Keywords: Carbon Reduction; Transportation Economics; Curriculum Development.

1. Introduction

Fossil fuels, as the primary source of energy in modern industry, are an indispensable part of it. However, this energy dependence has also brought serious consequences, namely the massive emissions of carbon dioxide leading to sustained global temperature rise, causing significant damage to the ecological environment, and posing enormous challenges to human survival and development [1]. Among them, the concentration of carbon dioxide increased by 40%, mainly due to fossil fuel emissions; The global surface temperature in 2020 increased by about 1.1 ℃ compared to a hundred years ago [2].

Therefore, greenhouse gas emissions caused by human activities continue to raise the temperature of the Earth's atmosphere and sea level, making climate change more rapid and drastic. If emissions cannot be effectively reduced in a timely manner, the habitable areas for humans will shrink, leading to catastrophic consequences and threatening human survival and development. To address the issue of climate change, the international community has formulated and implemented corresponding policy actions. Reducing greenhouse gas emissions is an effective action to address global negative climate change. In 1992, the United Nations Conference on Environment and Development held in Rio de Janeiro, Brazil, adopted the Framework Convention on Climate Change (UNFCCC), which marked the beginning of the international carbon governance system and the original framework for countries around the world to set carbon neutrality goals. According to the overall goals set by the UNFCCC, the United Nations Climate Change Conference (COP) has been held annually since 1995 to discuss the allocation of emission reduction tasks among countries. In this process, the Kyoto Protocol was established in 1997, and the term "carbon neutrality" was first proposed, dividing the world into two camps for developed and developing countries to fulfill their emission reduction obligations. In 2009, the 15th Conference of the Parties (COP15) in Denmark established the Copenhagen Accord, which set a goal of controlling the global temperature rise to no more than 2 ℃ by 2020 and called on countries to submit voluntary emission reduction commitments. In 2015, the Paris Climate Conference established the global climate change agreement. The Paris Agreement proposed a temperature control target of 1.5 ℃, requiring each party to submit its Nationally Determined Contributions (NDC) and establish a unified carbon emission accounting mechanism. Countries began to establish net zero emission climate targets within their respective regions, namely carbon neutrality targets.

China is a key participant in the global green and low-carbon transformation, and also the world's largest industrial country. Driven by industrialization, urbanization, and motorization, China's carbon dioxide emissions account for 26% of the global total. China has been actively promoting the integration of its climate governance system with the international community and addressing the many climate challenges brought about by human activities. In September 2020, China officially proposed the goals of peaking carbon emissions by 2030 and achieving carbon neutrality by 2060 at the 75th United Nations General Assembly, gradually becoming the guiding words for China's climate governance. The "dual carbon" target is a strategic decision proposed by China to address global climate issues. Based on this goal constraint, China proposes to deepen the promotion of green, low-carbon and clean transformation in various industries during the 14th Five Year Plan period, and achieve the goal of reducing carbon dioxide emissions per unit of GDP by 18%. In this context, the low-carbon transformation of the industry will face strict external constraints [3-5]. Industries closely related to carbon emissions, such as industry, transportation, and urban-rural development, have become the focus of low-carbon governance and systematic research in China [6]. Therefore, in the face of the impact of the "dual carbon" target, various industries need to consider how to cope with the challenges brought by new emission reduction tasks at present [7].

The transportation industry is an important pillar of the national economy, providing basic services and development momentum for regional economies. After 1990, the transportation industry developed rapidly, but it also brought serious environmental problems such as fossil energy consumption and carbon dioxide emissions [8]. According to the IEA's 2020 Energy Technology Outlook, global terminal energy consumption reached approximately 9.95 billion tons

in 2018, with transportation accounting for 29.09% of global terminal energy consumption and 24.64% of global carbon dioxide emissions. At present, China is undergoing rapid motorization, urbanization, and industrialization, and the development of the transportation industry will continue to maintain a sustained growth trend. However, its carbon emissions continue to grow, and further adjustments are needed in emission reduction technologies and energy consumption structure. It can be seen that the transportation industry currently faces significant pressure and a severe situation in reducing emissions, but there is enormous potential for emissions reduction. On October 27, 2021, the Chinese government released the "Action Plan for Carbon Peaking Before 2030", which specifies the "Ten Actions for Carbon Peaking". Among them, the green and low-carbon action of transportation is at a key position in achieving the carbon peak target, and it is proposed to adjust the transportation structure and accelerate the green transformation of the transportation industry. Therefore, the transportation industry is an important component of low-carbon strategy and a guarantee for stable growth of the national economy. Realizing low-carbon transformation in the transportation industry is not only an energy-saving and emission reduction requirement for the transportation industry to cope with energy consumption, environmental impact, and global warming, but also a necessary choice to achieve China's "carbon peak and carbon neutrality" goals.

Transportation, as one of the higher education majors under the background of the "dual carbon" goal, shoulders the responsibility of cultivating composite talents with scientific literacy, innovative consciousness, and comprehensive abilities. How to quickly feedback the changes in the transportation industry under carbon reduction targets to higher education is an urgent issue that needs to be addressed. This new change poses new challenges to the theoretical teaching of logistics talent cultivation in higher education institutions. Transportation Economics is a core professional course in the field of transportation and has become a consensus in the current professional training program. Through this course, students can master the economic principles inherent in the process of material circulation, enhance their understanding and recognition of the driving and constraining factors of transportation industry development, and thus possess the ability to accurately grasp the business forms, industrial trends, and development trends of the transportation industry from an economic perspective. How to integrate carbon reduction goals into the current training of transportation talents through course construction has become a topic that university teachers in this major must face for core courses.

2. Analysis of the Role of "Transportation Economics" in the Training System of Transportation Talents

2.1. The Nature and Teaching Rules of the Course "Transportation Economics"

Transportation Economics provides a direct theoretical foundation for students majoring in transportation to study other professional courses; Many universities offer courses in transportation planning and management, as well as logistics management, ranging from undergraduate, master's, to doctoral degrees, including the course "Transportation Economics". It provides theoretical analysis tools for students to understand the underlying operational logic in the transportation process, demonstrating its important role in the curriculum system of these majors. Transportation Economics is a product of the intersection and integration of economics and transportation studies. This course uses economic principles to analyze and solve phenomena and problems in material circulation, giving it a considerable theoretical depth. The difficulty in the teaching process of this course lies in how to help students integrate theoretical knowledge with practical problems and improve their ability to apply learned knowledge to solve practical problems.

Transportation Economics is suitable for conducting case teaching, using case teaching as a starting point, selecting cases around the course content, reforming and innovating teaching methods, guiding students to explore and discover the economic laws of material circulation through case analysis. This can not only improve students' problem-solving ability, but also enable excellent students to experience the joy of success brought by research and exploration, thus effectively breaking through the difficulties in the teaching process of this course.

The course of "Transportation Economics" is a fundamental and compulsory course for transportation majors. To cultivate students' economic thinking and practical ability to solve transportation economic problems, providing them with a solid economic theoretical foundation for their subsequent learning and work. From the current teaching situation, there is still a certain gap between the teaching objectives and content of this course and the requirements for achieving carbon reduction goals, lacking the organic integration of ideological and political elements with the course content. Therefore, it is necessary to consider the reform and construction of course content and teaching mode in the context of carbon reduction strategy, explore new models for cultivating comprehensive innovative talents in transportation in the era of carbon reduction, and then help achieve the strategy of building a strong transportation country and carbon reduction goals.

2.2. Teaching Objectives of "Transportation Economics" Centered on Carbon Reduction

The current teaching objective of "Transportation Economics" is to strengthen theoretical teaching and equip students with the ability to apply economic principles to analyze and solve practical problems in logistics operations; And take case teaching as the main line, explore new ways of teaching reform, and comprehensively improve students' abilities. Set up multiple types and levels of case teaching projects around the course content; Based on actual needs, explore the implementation of various teaching methods such as teacher lectures, student self-learning, group discussions, and online tutoring in case teaching; Explore the implementation of various assessment methods in case teaching, such as writing small papers, group research reports, student classroom PPT presentations, and classroom debates; The final students not only master the knowledge system of this course proficiently, but also achieve a certain degree of improvement in abilities such as problem analysis, problem solving, text writing, language expression, speech and debate, effectively meeting the requirements of modern transportation industry for talents' comprehensive application

of professional skills, logistics operation design organization and coordination ability, information acquisition, processing and analysis ability, and emergency response ability for emergencies. On this basis, improvements should be made with the goal of reducing carbon emissions. In theoretical teaching, when analyzing the laws of economic operation, it is necessary to point out the impact of different economic behaviors on carbon emissions and analyze carbon emissions as an important economic cost. At the same time, when teaching through case studies, update the content of the cases and focus on analyzing the gains and losses of economic behaviors in carbon emissions in the cases.

3. Content Design of "Transportation Economics" Course Based on Carbon Reduction Goals

3.1. "Transportation Economics" Design of Teaching Knowledge System for the Course of Transportation Economics

Transportation vehicles generally refer to cars, trains, ships, and airplanes. If we look back at the development history of these transportation vehicles, we will find that their exterior design initially focused on functional requirements, but with the improvement of technological level, aesthetic requirements will become increasingly important in exterior design.

At present, there are three different systems for the content of the course "Transportation Economics" in Chinese universities. The first type was proposed by British scholar Kenneth Barton, whose curriculum was designed based on the curriculum system of Western economics, with economics as the main perspective. The second approach mainly discusses transportation economic issues from three levels: market, enterprise, and country. This course system was quite popular in Chinese universities before the 1990s. The third type was proposed by the teaching team of the School of Transportation Engineering at Tongji University, which achieved the integration of the above two systems. Based on the first knowledge system, the knowledge from the second system was effectively integrated, taking into account the advantages of the first two knowledge systems. It has been adopted by most universities in China in teaching.

Refactoring the course of Transport Economics with a focus on carbon reduction, the content should be based on the third knowledge system and combined with students' professional characteristics to strengthen content related to their professional direction. Taking 48 class hours as an example, the knowledge structure of each part of the "Transportation Economics" course is shown in Figure 1.

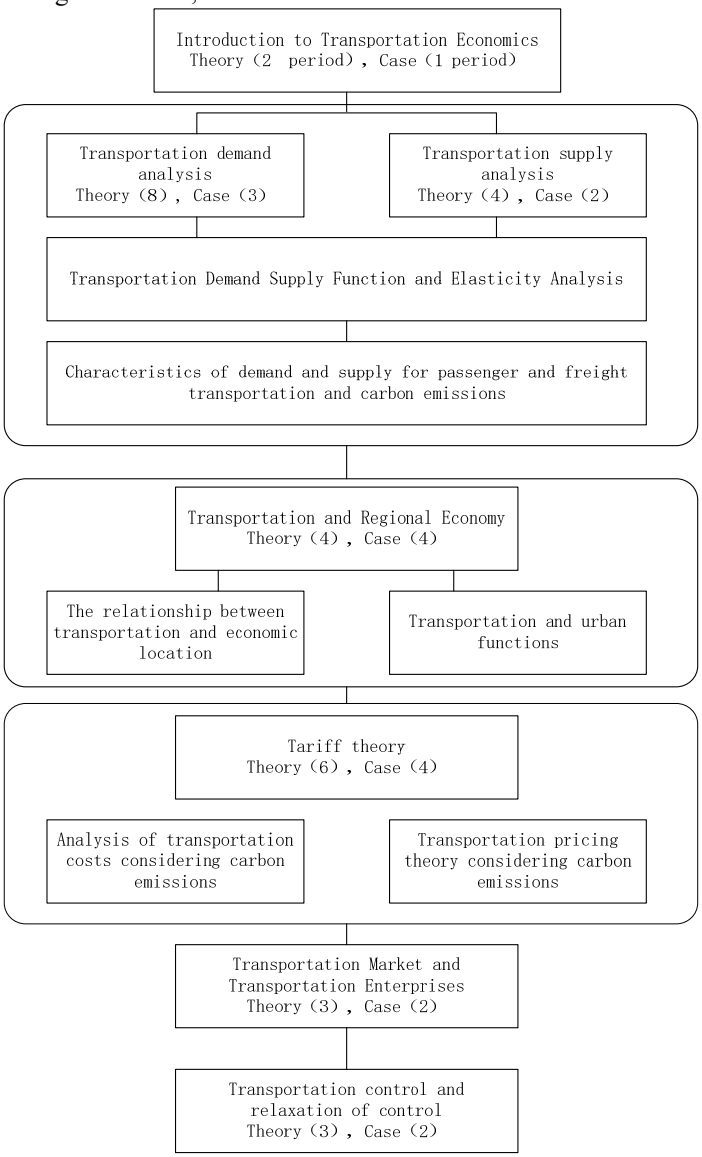

Figure 1. Structure of the Knowledge System of Transportation Economics

3.2. Content Selection and Arrangement of Case Teaching in "Transportation Economics"

Exploring new ways of teaching reform in the course of "Transportation Economics" with case teaching as the main line; Reform the teaching and assessment methods around case-based teaching. Therefore, case teaching plays a crucial role in the construction process of this project [9]. Figure 1 shows the knowledge system structure of "Transportation Economics" (class hours), and the different types of cases selected during the teaching process are shown in Table 1.

Table 1. Teaching situation of different types of case studies

Case name	Case type	Case content	Teaching objectives
China's Foreign Trade Channels and Geopolitics	Conclusion Open ended type	Require students to search for information and master the current status of China's foreign trade transportation channels and its relations with neighboring countries. Analyze the relationship between the two based on the knowledge taught in class, and propose carbon reduction methods and suggestions for existing foreign trade transportation modes.	Strengthen knowledge points, Exercise innovative thinking, group collaboration, and communication skills
Cross elasticity of demand prices for civil aviation and high-speed rail transportation	Calculation and analysis type	Require students to collect relevant data such as high-speed railway and air transportation prices and volumes outside of class, calculate the cross elasticity between the two, analyze factors affecting passenger choices, and propose future development strategies for the two transportation modes. Provide the carbon emissions per person per kilometer for two modes of transportation, and based on the analysis conclusions, provide price adjustment recommendations.	Strengthen the understanding of knowledge, exercise data calculation and text writing skills, and cultivate research interests
Economic Analysis of Transportation Layout in the US Steel Industry	Theoretical verification type	Using industrial location theory to provide a transportation economic explanation for the changes in the layout of the steel industry in the United States over the past 100 years since 1900.	Cultivate students' ability to analyze problems, exercise their language expression and debate skills
Economic analysis of transportation for cross sea bridges	Integrated application type	The teacher introduces the situation of Hangzhou Bay and the Guangdong Hong Kong Macao Bridge, and students conduct transportation economic analysis on them, and compare the changes in regional transportation carbon emissions before and after the completion of the project.	Exercise students' ability to comprehensively apply knowledge and analyze problems

4. Innovation of Teaching Methods for Transportation Economics Based on Capability Requirements

4.1. Innovation in Teachers' Teaching Methods

(1) Traditional lecture style. Given the theoretical depth of 'Transportation Economics', adopting the traditional lecture style teaching method with teacher led instruction is not only necessary, but also essential. The traditional lecture style mainly focuses on the teaching content of non-case analysis in this course, especially in the teaching of difficult, important, and difficult to understand content in this course. It is necessary to adhere to the teacher's teaching as the main approach.

(2) Inspired and guided. In the process of case teaching, adopting an inspiring and guided teaching method often achieves good results. For example, in the teaching process of transportation economic analysis cases for the construction of cross sea bridges, teachers guide students to analyze the role of cross sea bridges from the perspective of leveraging the industrial location of seaports; Analyzing the planning and construction of the Bohai Bay Cross Sea Passage project in China from the perspectives of the construction reasons of the Hangzhou Bay Bridge, the Guangdong Hong Kong Macao Bridge, and its driving effect on the regional economy, and analyzing the gains and losses of the construction from the perspective of carbon emissions, can effectively improve students' learning outcomes.

(3) Interactive communication style. In the process of case-based teaching, adopting interactive and communicative teaching methods can help enhance students' enthusiasm for learning. For example, in the process of case teaching, students can present their specific viewpoints on a case through classroom PPT presentations and then answer questions from the teacher or other classmates. This teaching format not only exercises students' abilities in various aspects, but also enhances the enthusiasm of all students to participate in classroom discussions, achieving multiple effects.

(4) Personalized coaching style. Personalized tutoring for students can timely identify problems they encounter in learning, provide targeted assistance, and have a positive effect on improving their learning efficiency and interest. This course can provide personalized tutoring for students through reviewing case analysis reports, online communication, individual conversations, etc.

4.2. Innovative Ways for Students to 'Learn'

(1) Actively creating an environment for students to learn from each other. Mutual learning among students has a good effect on learning from each other's strengths and weaknesses, and improving their comprehensive abilities; Through mutual learning, students actively acquire the knowledge they have learned, resulting in higher learning efficiency [9]. When conducting case teaching, conducting group discussions, student evaluations, course debates, etc. are all conducive to creating an environment and atmosphere for students to communicate with each other, and promoting the realization of mutual learning among students.

(2) Encourage students to engage in online learning. By building a comprehensive course website that gathers basic information related to the study and research of Transport Economics, it facilitates students' online learning; In addition, by improving the online communication platform and expanding its scope of use, we actively attract students of different grades, other teachers, and even industry practitioners to use the platform for communication and consultation, so that students can use the internet to obtain

more relevant knowledge.

5. Conclusion

Under the background of the "dual carbon" strategy, reconstruct the content and teaching mode of transportation economics courses, explore new models for cultivating comprehensive innovative talents in transportation majors in the "dual carbon" era, and then help achieve the strategy of building a strong transportation country and the "dual carbon" goals. Based on the latest developments in carbon neutrality research, update teaching content in a timely manner and improve teaching methods and tools. Integrating the concept of "dual carbon" organically into the teaching and practice of courses, providing theoretical support for promoting the discipline construction of "dual carbon" related majors in universities and cultivating "dual carbon" technology innovation talents that meet the needs of the times.; This article explores "Transportation Economics" as an example, hoping to provide some reference for teachers' teaching.

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