Exploration on Teaching Reform of Traffic Planning Course for Applied Undergraduate Transportation Major Oriented by the Training of Innovative Engineering Talents

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Abstract. "Traffic Planning" is a compulsory course for transportation majors in applied undergraduate universities, which emphasizes the intersection and integration of multiple disciplines. In this paper, the problems faced by the training of traffic planning talents were analyzed. On this basis, the teaching reform was explored from renewing the teaching materials and courseware, adjusting the teaching structure and content, reforming teaching methods and means, constructing an open practical teaching system and optimizing the assessment model. This reform is of great significance to the cultivation of students' engineering practice ability and theoretical innovation spirit.

Introduction

To Meet the Needs of the Transportation Infrastructure Connectivity under the Integration of the Guangdong-Hong Kong-Macao Greater Bay Area

In March 2016, the state clearly put forward the strategy of building an international comprehensive transportation hub in Guangzhou. Recently, the Central Committee of the Communist Party of China, the State Council printed and issued Outline of the Development Plan for the Guangdong-Hong Kong-Macao Greater Bay Area, which proposed that the infrastructure Connectivity should be accelerated and a modern comprehensive transportation system should be constructed to take part in the development of the Belt and the Road. Therefore, there is a growing demand for various types of high-level traffic planning talents for institutions and enterprises engaged in transportation consultation and technology services.

To Meet the Needs of the Development of Big Data Technology

In the era of big data, "Internet + traffic", which deeply integrates the new generation of information technology with transportation, has become an effective means to improve urban traffic problems. It gradually leads to the upgrading of the entire transportation system [1]. Big data enriches the data resources, deepens the mathematical model and updates the application methods for traffic planning course. Therefore, it requires that the teaching of traffic planning course should keep pace with the times and pay attention to the cultivation of students' comprehensive quality.

To Meet the Needs of the Nature of the "Traffic Planning" Course

Traffic planning, as a comprehensive and cross-border course, involves many aspects such as society, nature, economy, humanities, politics, land use and so on. It is also a difficult course to teach and learn.

Institutions offering this course are divided into three categories: the first is the traditional civil engineering colleges, which are characterized by traffic and civil engineering; The second is the traditional automobile transportation colleges, which are characterized by road traffic management and planning; and the third is the traditional railway colleges, which are characterized by the comprehensive transportation planning of railways and highways. At present, the construction of traffic planning courses in Southeast University, Tongji University, Beijing Jiaotong University, Chang'an University and Beijing University of Technology is relatively mature. For example, the
main feature of Southeast University is taking real engineering projects undertaken by the national key disciplines "Transportation Planning and Management" and the national excellent course "Traffic Planning" as the background which support teaching [2-3]. The course is also one of the most important ones with the longest history and the greatest impact in transportation specialty. School of transportation in Tongji University is one of the earliest research institutes to introduce advanced foreign traffic simulation analysis software which was used in experimental teaching [4-5].

To Meet the Needs of the Construction of Applied Undergraduate Majors

Guangzhou Maritime University is an applied undergraduate university in which Transportation is a provincial Demonstrative specialty for applied talents training. Traffic planning is also the main course in the talent training plan of transportation specialty. Therefore, the teaching of traffic planning course should be guided by engineering application. Due to the short opening time of this course and the relatively less training of transportation major received by students, students are often in a state of passive absorption of knowledge in the learning process, lack the corresponding practical training, and cannot grasp the whole process method of traffic planning. Thus the teaching and practical links of traffic planning course still need to be improved. With the deepening of higher education reform, the goal of talent cultivation tends to be more comprehensive and applied, and the cross-penetration and mutual reference between disciplines is also an inevitable trend [6-7].

Problems in the Training of Traffic Planning Talents

The Obsolescence of Basic Theory and Technology

The traditional traffic planning theory is based on statistics and traffic models represented by the "four-stage" method in which the randomness, representativeness and timeliness of the sample data have inherent defects, which affect the reliability of the model. Traditional technology and means have obviously lagged behind. Big data technology has brought new means for the innovation of traffic planning technology, such as mobile phones, GPS etc., which can obtain large samples, or even full samples of urban residents' travel data, and help to make more accurate judgments of traffic demand. This is a comprehensive challenge to the traditional planning theory. In addition, traditional planning often has the color of elite planning which is dominated by the values and concepts of government leaders and experts. Traffic planners in some cases only play the role of public interest spokesperson. On some occasions, the degree of public participation is low, and the phenomenon of individualism worship of planning is still widespread when planning is publicized. Big data makes it possible for a broad, open and multi-faceted public to participate in planning which will subvert traditional traffic planning ones.

The Lagged Renewal of Curriculum System

The lag of curriculum system renewal is mainly reflected in the slow renewal of knowledge content of new technologies related to traffic data in textbooks. Taking which is the basis of the whole traffic planning as an example. At present, the content of the traffic survey is still based on the traditional survey technology such as field survey, interviews, questionnaires and other manual surveys. New methods and technologies such as mobile signaling acquisition, network capture and GIS resident trip survey based on large data have not been integrated into the textbooks in time. As for the theoretical basis of traffic planning, "four stages" cannot meet the needs of decision support in the era of big data where judgments except traffic flow analysis are pushed to "experience", and the advantages of big data are not fully utilized to provide theoretical and technical support for traffic planning. Furthermore, traffic analysis is often confined to "traffic flow" prediction, not extended to "spatial vitality" and "transferable flow analysis". GIS technology, data mining technology and visualization technology are not included into the curriculum system of this major in time, so the existing curriculum system lags behind the practical application.

The Relatively Weakness of the Faculty

Higher training objective of traffic planning personnel has raised the standard of faculty. Ideal
teachers not only have the professional technology of traditional traffic planning, but also have the ability of collecting, processing, analyzing and releasing traffic data. They are typical compound and applied talents with innovative consciousness and practical ability. But in reality, most of the teachers and engineers in traffic planning specialty lack the ability to deal with traffic data effectively. Most of the elders are unwilling to enter this new technology field. Most of the younger ones have mastered some big data application technology, but they lack rich teaching experience and practical experience. In addition, the rapid updating of big data technology makes it difficult to upgrade the level of teachers in traffic planning in time.

Lack of Foundation for Training Talents
Traffic planning emphasizes multidisciplinary intersection and integration which mainly studies the theory and method of transportation system planning, decision-making and management. It pays attention to the training of theoretical innovation and practical ability, and focuses on training high-quality talents with innovative ability.

Due to the high goal of personnel training, there is no major of traffic planning in the undergraduate stage. The major of transportation planning and management was not established until the postgraduate stage, in which the reserved talents is mainly from transportation engineering, transportation, logistics engineering, urban planning and other related majors. Although the students of transportation majors have accumulated some planning theory knowledge at the undergraduate stage, their computer level, information processing and mathematical model technology are very weak. On the contrary, the students of other related majors lack the theoretical basis of traffic planning. Therefore, the students' professional basic levels are uneven for this kind of interdisciplinary, which leads to the difficulty of training. With the transformation of traffic planning technology in the big data environment, the training requirements and difficulties of the talents will be further increased.

The Renewal of the Teaching Materials and Courseware
The teaching content of traffic planning should be in line with the frontier issues in the field of transportation at home and abroad, which make students understand the hot issues in the industry and stimulate students’ interest in learning. At present, there are many textbooks for traffic planning courses in China, but most of them are single and outdated, lacking the analysis and interpretation of the latest traffic problems. The existing textbooks should be updated referring to the latest achievements in the field of transportation research at home and abroad to encourage students to explore new knowledge. Thus, students can grasp the latest research directions in this field while learning basic knowledge. In the aspect of teaching courseware, the traditional teaching courseware often summarizes and refines the content of the textbook which make students feel dull and uninterested. From the perspective of intersection and integration between disciplinary, traffic planning courseware should not only meet students’ needs for professional knowledge, but also expand their knowledge as much as possible, so that students can realize that no disciplines can exist in isolation, view the existing traffic problems from different perspectives, and try to use the model method of other disciplines to analyze traffic data. In addition, in the teaching courseware, the current hot traffic topics can be properly introduced for students to discuss in class to stimulate students’ interest in studying traffic problems.

The Adjustment of the Teaching Structure and Content
We should further select theoretical teaching content, compress the theoretical teaching hours of some the original knowledge points, strengthen the advanced and practical teaching knowledge points, and increase the proportion of practical teaching. In teaching, we should pay attention to the real-time combination of knowledge learning and application and the standardization of practical training, so that the cultivation of students' engineering consciousness and practical ability runs through the whole process of teaching. The teaching content should not be limited to the textbook.
Nowadays, traffic flow, travel time, and travel speed data can be obtained. Traffic planning can make full use of existing and historical traffic data to predict and plan future traffic conditions. Therefore, on the basis of teaching traditional planning theories and methods, the teaching of traffic planning course must use the existing traffic data, integrate the analysis models of traffic engineering, operations research, management, economics and other related disciplines to optimize the content system of traffic planning course as follows:

**The Ability of Traffic Planning Theory Knowledge and Application.** It mainly includes the research content, methods, process, the selection of model, the determination of model parameters and so on.

**The Ability of Traffic Data Acquisition.** It mainly includes the determination of the content, method and instrument of data acquisition.

**The Ability to Analyze and Process Traffic Data.** The main purpose is to train students' ability to extract the required information from a large number of basic data collected according to the requirements of traffic planning. Some models and methods of economics, management may be used to explain traffic phenomena and solve traffic problems.

**The Ability of Traffic Simulation.** The main purpose of this study is to cultivate students' ability to simulate traffic flow on road sections by using the acquired basic traffic data.

**The Ability to Apply Traffic Planning Software.** The main requirement is to master the use of typical traffic planning software.

**The Ability to Show Traffic Planning Results.** Through the demonstration of planning results, the ability to express, draw and make PPT can be trained.

In the above training abilities, students should master the traffic planning and simulation software trans CAD, traffic mapping software AutoCAD, geographic information software ArcGIS and data statistics software SPSS.

**Reform of Teaching Methods and Means Based on Problem-Driven and Case-Oriented**

At present, with the rapid development of China's transportation industry, railway, highway, aviation and water transport tend to be high-speed, intelligent, environmentally and humanized, which puts forward higher standards for the training of comprehensive and innovative talents of traffic planning. Therefore, the teaching content of traffic planning course is extensive and profound. We must strengthen the applied and practical teaching, and pay attention to the cultivation of comprehensive quality. Thus the teaching reform of traffic planning course is carried out by using case-oriented and question-driven methods and means.

**Questions-Driven Teaching Method**

In view of the difficulties of interaction between teachers and students in traditional traffic planning teaching, the problem-driven teaching method is adopted. The key and difficult points of the course are designed into a series of specific problems from elementary to profound. The core of heuristic teaching method lies in the design of heuristic problems, which come from the realistic or theoretical needs, including the questions of knowledge cohesion and practical needs.

**The Questions of Knowledge Cohesion that Connect the Existing Knowledge Points with the Unknown Ones.** On the one hand, before introducing knowledge points at the beginning of each class, teachers can ask questions related to the content of the previous ones. On the other hand, after explaining the knowledge points in each lesson, teachers can put forward some questions related to the subsequent course. For example, before introducing the introduction, several questions can be asked as follows: “What kind of traffic problems do you often encounter”? A summary can be made after they answered the questions, and then the position and role of traffic planning in solving traffic problems are naturally drawn out. When explaining the meaning of traffic planning, "What is your career plan?" can be asked first. Then the scientific definition of traffic planning can be given. Finally "You should start to plan your life, career and life
scientifically now." can be told to students. The questions-driven method helps to design a series of interrelated questions between knowledge points and theory and practice. Then the awareness of discovering, analyzing and solving problem can be established, and the correct scientific literacy can be cultivated.

**The Questions of Realistic Demand Which Refer to the Statistical, Forecasting, Evaluation and Design Questions from Actual Traffic Planning Needs.** The questions may come from the explanation or description of traffic phenomena, or from the difficulties or solutions encountered in scientific research and practice. For example, when explaining the five transportation modes, you can ask the students the following questions: "Which mode of transportation do you prefer? Why?" When introducing the form of urban road system, we can ask, "What is the form of Guangzhou's road network? Why can't we build a road network like what in Beijing?" Through these problems, students can understand the relationship between the actual needs and the development of theory.

**Case-Oriented Teaching Method**

Teaching content should be combined with engineering practice. We can carry out case-based teaching combining teaching knowledge with engineering projects. Traffic planning is the core course of transportation specialty which is closely related to the practice of traffic engineering. The engineering practice projects such as urban traffic planning, public traffic planning, parking planning, and road network planning are closely related to the traffic planning curriculum. The scenarios of traffic planning project " can also be created in the course of teaching to let students analyze and design projects in groups. It can not only enhance students' interest in traffic planning courses, but also improve their application ability, which is of great significance for training high-quality comprehensive talents. Firstly, teachers can use traffic planning software to compile virtual cases to enhance students' the ability of application of theoretical models and algorithms. For example, a virtual case can be used to explain the P-A balance in the process of travel generation prediction. With the help of virtual cases designed by professional software, students can have a deeper understanding of the essence of theories, formulas and algorithms. They can also familiarize themselves with professional software and cultivate their ability to grasp the essence of problems and solve practical problems.

On the other hand, the traffic planning cases from engineering practice can be introduced. Then, students can understand the actual sources of traffic planning problems and feel the significance of traffic planning theory to engineering practice.[11-12]

**Construction of an Open Practical Teaching System**

**The Integration of Practice Project and Basic Theory Teaching**

**Thematic Research.** Some deep-seated tips and guidance of thematic research are given for some knowledge units and points. Students are required to independently study, research and then write research reports on the basis of searching and reading relevant literature. From this, the following abilities can be cultivated: the ability of data retrieval, summary and synthesis; the ability of comprehensive application of curriculum knowledge; the ability of research and exploration; the ability of collating and writing research reports, etc.

**Thematic Discussion.** Students are required to make use of extracurricular time to conduct on-site inspection, data collection and problem analysis on actual traffic planning issues, propose one or more planning plans, and then discuss them in class through division and cooperation. Everyone has to speak and fully display his personal and team views. Finally, the teacher comments and summarizes.

**Thematic Design.** A number of comprehensive thematic planning and design projects are arranged to further penetrate the teaching content of related courses and embody the integration of theory and practice. The practical abilities that need to be trained are as follows: the ability of basic data collection and analysis; the ability of traffic demand forecasting; the ability of traffic planning scheme design, optimization and decision-making; the ability to use the relevant national...
regulations flexibly and rationally; the ability to evaluate and analyze traffic planning schemes and to apply related software.

**Lectures on Special Topics.** Combining with the expansion and improvement of teaching content, the application of traffic planning technology and methods in engineering, the students' extracurricular innovative practice projects, and the analysis of typical engineering design cases, we invite experts from home and abroad to offer some special lectures to further consolidate the theoretical basis, broaden professional horizons, establish correct planning concepts, and improve the ability of engineering awareness, quality and engineering practice. At the same time, the ability of expression and communication is cultivated through the interactive discussion between students and experts.

**Simulation Experiment.** Different levels of practical training are realized through the design of a series of simulation experiment projects. First, the application method of basic knowledge of the course can be mastered through the basic and improvement of traffic macro-simulation software. Second, comprehensive traffic simulation can be achieved in combination with the needs of thematic design practice; Third, the ability of innovative learning can be cultivated and expanded by the simulation software.

**Organization and Application of Practical Teaching**

**Selection of Practical Materials.** The practical teaching materials should be chosen according to combination of practical materials and courses. The projects which involve a large area and have a computational complexity in the practical application of traffic planning are not suitable for teaching. Therefore considering the practical ability of students and the time requirement of practical courses, some small and precise projects with relatively small workload and complete contents should be selected, so that students can not only understand the whole process of traffic planning from a global perspective, but also have a better degree of completion.

To Clarify the Relationship between Materials and Knowledge. In the process of designing practical teaching materials, we should set up corresponding questions in the required places, and prompt students to combine the theoretical knowledge points learned with practice. For example, in the teaching of traffic survey, students can complete the questionnaire design by themselves to consolidate the theoretical knowledge. In the specific organizational process, we should emphasize several important knowledge points, so that we can better evaluate the completion of students in the follow-up results summary.

**The Perfection of Teaching Organization.** Careful arrangements should be made before practical teaching. First of all, we should clarify the purpose of practical teaching, and divide students into groups according to students' gender, personality characteristics, collaborative ability, and so on. Each group chooses a deputy group leader to be responsible for the coordination of the group. Secondly, periodic assessment should be conducted in the process of implementation. In view of some problems arising in practical teaching, answer questions for students in time. In view of some problems arising in practical teaching, we should solve them in time. Finally, after the end of the practice teaching, each group will issue a practice report which records the purpose, content and achievements of this practice in detail.

**Summarizing the Teaching Effect Conscientiously.** After the end of practical teaching, we should evaluate the practical ability according to the students' performance in the teaching process. Multi-level scoring system can be used, where member scored each other to fairly reflect the actual learning effect.

**The Optimization of Assessment Mode**

The course assessment plays a very important role in the standardization and quality of teaching. The theory and practice teaching of "traffic planning" course are inseparable. According to the respective characteristics of the two teaching methods, this paper the method system of course assessment is put forward as shown in Table 1.
Table 1. Assessment system of traffic planning course.

<table>
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<tr>
<th>Composition of Achievements</th>
<th>Contents of assessment</th>
<th>Requirements for assessment</th>
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<tbody>
<tr>
<td>Peacetime homework</td>
<td>Exercise assignments for the theoretical part</td>
<td>According to the outline, the students should grasp the concept of professional terms in basic theory and use basic models to carry out simple calculations.</td>
</tr>
<tr>
<td>Evaluation of Comprehensive Practice Ability</td>
<td>Thematic research</td>
<td>Through data retrieval, self-learning and research, special research reports should be written. It can be combined with simulation experiment.</td>
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<tr>
<td></td>
<td>Thematic discussion</td>
<td>The problems of practical traffic planning can be analyzed from a professional point of view and put forward clear views.</td>
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<tr>
<td></td>
<td>Thematic design</td>
<td>The students should complete a comprehensive thematic planning and design project and form a thematic design report. It can be combined with simulation experiment.</td>
</tr>
<tr>
<td></td>
<td>Special lectures</td>
<td>External industry experts are invited to give lectures, and the experiences are required to be submitted in conjunction with the contents of the lectures.</td>
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<tr>
<td></td>
<td>Experimental simulation</td>
<td>The students should complete a series of simulation experiments, which can be combined with thematic design and research.</td>
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<tr>
<td>Final exam</td>
<td>Written Examination of Basic Theory</td>
<td>Theoretical part: The students should master the concept of professional terms in basic theory, and be able to use basic models to carry out simple calculations.</td>
</tr>
<tr>
<td></td>
<td>Written Examination of Practical Application</td>
<td>Practical part: The engineering practice case can be analyzed scientifically and comprehensively, and the related application of practical technology can be understood.</td>
</tr>
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</table>

It should be pointed out that the assessment of traffic planning course is throughout the whole course of teaching which pays more attention to the process of students' learning and practice. Through the above methods of standardized assessment, students can have a comprehensive understanding of the process and methods of traffic planning. The teachers can have a timely understanding of students' mastery of the course and objectively give comprehensive assessment results.

Summary

The traditional teaching model is not completely applicable to the course of traffic planning due to its characteristics of multidisciplinary intersection and engineering. In view of the problems faced by the training of traffic planning talents, the training of engineering practical ability and theoretical innovation spirit is taken as the key point, and the training of traffic planners is taken as the goal. Through updating curriculum textbooks and courseware, adjusting teaching structure and content, reforming teaching methods and means, constructing an open practical teaching system and optimizing assessment model, students' basic engineering knowledge, team communication ability and engineering system ability can be improved to meet the requirements of enterprises for traffic planning talents.

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