Research on Practical Teaching of Traffic Information Analysis and Application Course under the Background of New Engineering

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Abstract: The New Engineering Education places higher demands on the cultivation of professionals in public security and traffic management. It is necessary to carry out ins tructional reforms in the practical segment of relevant courses. This article takes the pr actical segment of the "Traffic Information Analysis and Application" course in the Tra ffic Management Engineering major at Gua ngdong Police College as a case study. Analy zing the deficiencies in the existing practical segment based on the characteristics and tea ching objectives of the course. The paper in conjunction with the OBE concept, proposes reform approaches for the practical segmen t, outlines the design of the practical segmen t, practical teaching model and assessment mechanism. At present, the curriculum refo rm program proposed in this paper has bee n initially implemented. This study can prov ide a reference for the practical teaching ref orm of similar courses in traffic managemen t engineering.

Keywords: Transportation Management Engineering; Transportation Information; Practical Teaching; OBE; New Engineering

1. Introduction

In response to the strong demand for reform in higher engineering education driven by the characteristics of the new economy, featuring new technologies, industries, formats, and models [1], the Ministry of Education proposed the concept of "New Engineering" in 2016. Since February 2017, the Ministry of Education has actively promoted new project construction. New Engineering is a new generation of engineering education with engineering as the core, driven by technology, and oriented towards industry, emphasizing the close integration of technology and society [2]. The Traffic Management Engineering major in police academies, although integrating multiple disciplines such as public security, psychology, law, and management, has similar requirements for cultivating students in engineering disciplines. The focus is on knowledge-based, skill-oriented, and high-quality education. Many police academies' Traffic Management Engineering majors have conducted research, exploration, and practice related to curriculum and teaching reforms under the influence of the "New Engineering" talent cultivation concept, but most are still in the early stages [3, 4].

As a core course offered in the third semester of the Traffic Management Engineering major at Guangdong Police College, "Traffic Information Analysis and Application" aims to provide students with a fundamental understanding of traffic information, including the principles of data collection, transmission, and the application of analytical methods. The course emphasizes cultivating students' ability to think critically about the processing, analysis, and application of traffic data from an engineering perspective. With the Outcome-Based Education (OBE) philosophy at its core and considering the demand-oriented requirements of the public security traffic management department [5-6], it is crucial to enhance the teaching of the "Traffic Information Analysis and Application" course. In light of the "New Engineering" requirements for cultivating talents in the Traffic Management Engineering major, it becomes imperative to reform various aspects of the course, including its structure, project design, teaching model, and assessment mechanism.

2. Overview of the Original Practical Segment

The original practical segment of the course primarily adopted a phased independent practice method. Students were required to analyze given data using theoretical knowledge, standardized methods, and software tools learned in the current chapter to deepen their understanding of the theoretical knowledge and practical skills of the respective chapter. However, as the practical topics were chosen based on the content of teaching chapters, i.e., data analysis steps, the data types and content were scattered and lacked coherence. Students often found themselves restricted to the requirements set by the teacher, making it difficult to conduct comprehensive traffic data analysis and application throughout the entire process, starting from data preprocessing. This not only hampers students' establishment of a complete cognitive understanding of the course content but also impedes the development of their innovative thinking and engineering practice skills. This could lead to a reduction in students' interest in the course, negatively affecting the teaching effectiveness. Moreover, the current practical teaching design deviates somewhat from the requirements of talent cultivation in the "New Engineering" era.

3. Reforming Practical Teaching in Courses

According to the OBE teaching philosophy, practical teaching should be student-centered [7], focusing on teaching outcomes. In the OBE teaching model, teachers must clarify the course's learning objectives, design practical teaching activities that can achieve these objectives, and assess students' learning outcomes to determine if the objectives are met [8]. Therefore, the reform of the practical segment, considering the characteristics of the Traffic Management Engineering major, emphasizes task-driven, full participation, innovative thinking cultivation, enhancement of engineering practical skills [9], teamwork training, autonomous practice, and autonomous learning. The specific reform ideas include following points.

3.1 Integration of Practical Training Cases throughout the Course

In order to strengthen the coordination between practical training courses and theoretical knowledge courses, and enhance the integrity of teaching in the Traffic Information Analysis and Application course, practical training cases should, as much as possible, encompass knowledge points related to various aspects such as traffic data acquisition, transmission, storage, analysis, and application. This allows instructors to approach training exercises from different perspectives based on actual teaching needs, ensuring both the completeness of knowledge instruction and the continuity of content.

3.2 Enhancement of Student Active Engagement in Practical Activities

The teacher's role should shift to providing guidance, especially in areas such as teamwork, data selection, formulating analysis approaches, conducting analysis processes, and evaluating final results.

3.3 Promoting Team Collaboration with Projects at the Core

Students should be grouped for project-based learning, with students possessing leadership qualities acting as group leaders. These leaders, in conjunction with selected practical topics and traffic information data packages, should be responsible for planning practical activities, assigning tasks, and organizing team members to implement the practical plan. This cultivates teamwork spirit and engineering practice literacy. Following the OBE teaching philosophy, teacher guidance should be student-centered, with feedback obtained through stage presentations to address learning issues promptly.

3.4 Reinforcement of Comprehensive Skill Training

Alongside imparting course knowledge, emphasize the logical and scientific aspects of information processing and analysis. Students should be able to use software such as Excel and Access to carry out practical activities, enabling them to develop basic operational capabilities in storing, preprocessing, analyzing, and applying traffic information data.

3.5 Emphasis on Enhancing Engineering Practical Skills

In line with the demands for the capabilities of specialized talents in public security traffic management, field investigations and engineering practice segments will be added. This allows students to gain in-depth insights

into the actual operation of intelligent traffic management systems. Additionally, based on school-industry collaboration platforms, public security and technical experts will be invited to the classroom to impart practical experience, share the latest technological methods, and present case studies in traffic information analysis and application. Through typical case studies, students can enhance their engineering practice skills.

3.6 Cultivation of Research Writing Skills

Encourage students to write scientific papers by analyzing traffic information data. This serves as a comprehensive assessment of students' mastery of the knowledge in the course "Traffic Information Analysis and Application." It aims to enhance research writing skills and disseminate scientific knowledge.

3.7 Focusing on the Cultivation of Innovative Awareness

By leading students in on-site inspections of various traffic management systems, understanding the practical applications, underlying logic, application models, system functionalities, and adopted new technologies of various traffic data, students' research interests in traffic information data analysis, interpretation, and decision support within this professional field will be stimulated. This approach broadens students' perspectives, hones their innovative awareness and capabilities, and provides profound insights into the development forefront of smart traffic management technologies and application systems.

3.8 Diversification of Teaching Methods

To accommodate the different characteristics of practical activities, various teaching modes such as centralized lectures, group discussions, teamwork, group presentations, and oral defenses will be adopted. This aims to promote innovation and improvement in teaching methods.

3.9 Comprehensive Evaluation of Practical Achievements

Through multifaceted assessments covering teamwork, participation levels, analytical abilities, report and writing quality, oral defense skills, and more, the OBE teaching model will be completed through feedback. This helps to stimulate students' enthusiasm for participation in practical activities and comprehensively enhances the effectiveness of practical teaching.

4. Design of Practical Teaching Segments

Addressing the shortcomings of the original practical teaching in the course and aligning with the reform ideas, a new design for practical teaching segments has been proposed.

4.1 Comprehensive Analysis Experiment

Building upon the existing course training, students will now organize teams independently. The teacher will provide a series of complete datasets, including traffic flow data, urban traffic accident data, driver and accident-related information, etc. Students, through group discussions, will choose experimental research topics based on the knowledge gained from traffic engineering, public security traffic management courses, on-site visits, expert lectures, and other information. Throughout the course, students will preprocess, analyze, judge, and apply improvements to the selected data according to the teaching stage. This cultivates students' data analysis thinking, processing capabilities, and innovative abilities. This approach not only maintains the continuity and completeness of practical course learning but also enhances students' ability to apply a variety of knowledge and experiences to solve real-world problems. The submitted results for comprehensive analysis include data processing and application reports. The data report should cover the logical model of data analysis proposed based on structured methods and tools, including the data preprocessing process, data governance results, data volume analysis, and data analysis results. The application report should include the reasons and significance of the problem studied, the thought process of data analysis, the data analysis process, overall analysis results, data application status, and the design of problem improvement solutions, presented in a standard format.

4.2 Engineering Practice

Engineering practice requires students to integrate their professional background and occupational perspectives, focusing on

researching actual business requirements in the field of public security traffic management. The reform of the course practice mainly includes on-site inspections and exchanges, as well as expert lectures by professionals from public security traffic management bureaus. Students will visit the Intelligent Traffic Command Center of the Guangdong Provincial Public Security Department Traffic Management Bureau and the Guangzhou Traffic Police Detachment, gaining in-depth insights into the functions, architecture, and application scenarios of key information systems such as the Public Security Traffic Management Comprehensive Application Platform, Comprehensive Integrated Command Platform, Big Data Analysis Platform, Motor Vehicle Source Tracking System, and checkpoint systems. Students will then compile detailed inspection reports. Special lectures will invite business experts from traffic management bureaus and city detachments, as well as technical experts from traditional traffic technology companies and internet enterprises, to analyze the latest business cases. Students will learn from and engage in on-site exchanges with experts and write reflective reports.

4.3 Scientific Paper Writing

The "New Engineering" education concept requires students not only to have solid professional knowledge and engineering practice skills but also research capabilities. Since "Traffic Information Analysis and Application" is a comprehensive course that combines information technology, traffic engineering, public security, and other interdisciplinary knowledge, students can write a scientific paper addressing the issues in public security traffic management based on the combination of various course knowledge, on-site inspection experiences, grassroots internship experiences, expert lecture content, personal life experiences, and interests. The paper should have a clear research object, research purpose, and research significance, rigorous research and writing logic, a complete structure, standardized format, fluent writing style, rigorous formality, and highlighted key points.

5. Reform of Practical Teaching Modes

In comparison to the past, significant changes have been made both in the form and content of the new practical teaching mode, demanding higher capabilities from both students and teachers. Considering that third-year students are still in the process of constructing their professional knowledge, they may encounter various challenges during practical applications. This requires teachers not only to have a profound academic background but also solid theoretical knowledge, professional expertise in public security traffic management, and practical experience. This ensures their ability to analyze and solve problems arising during practical applications and provide timely guidance and supervision. For different practical modules, this study has designed corresponding teaching strategies and methods. For the comprehensive analysis experiment, teachers will guide students to understand conventional traffic data processing and analysis techniques. Simultaneously, real-world cases are integrated to cultivate students' sensitivity to data. Students are required to master the logic and methods of data analysis reflected in the cases. During the practice, students will organize midterm reports. Teachers and students will jointly discuss and provide suggestions on the feasibility and analysis results of the reports. At this stage, teachers will also guide students in their comprehensive practice, offering timely feedback and guiding adjustments to ensure the smooth completion of tasks. This emphasizes the independence of students' practical experience, hones their ability to apply learned knowledge comprehensively, and develops their skills in analyzing and solving complex problems.

Engineering practice necessitates a close connection between training content and real-world public security traffic management scenarios. In a real-world context, the integration of theoretical teaching content with actual business requirements is promoted to train students in problem identification and resolution. By inviting technical personnel from practical units and experts to explain, students, in groups, raise questions and engage in on-site discussions with technical personnel and experts. This encourages students to understand specific application scenarios of traffic information in actual traffic management and methods to address practical business pain points. Students are also required

to focus on traffic management business-related content relevant to the practical topics from their professional backgrounds.

For scientific paper writing, teachers will primarily guide students in data searching, literature review, and the standardized writing of scientific papers. Simultaneously, advice will be provided on topic selection to ensure that students can write logically rigorous, structurally sound, and substantively rich academic papers.

6. Assessment Mechanism for Practical Components

Diverse assessment mechanisms are employed for practical outcomes, utilizing different assessment methods and requirements for various types of practical content [10].

Comprehensive Analysis Experiment. Students are required to utilize the knowledge gained in the course along with relevant software tools for analysis, and the submitted documents need to adhere to established format standards. The key focus of assessment includes language proficiency, the rationality of analysis, the scientific nature of proposed application solutions and improvement measures, the accuracy of analysis methods, appropriateness of chart representations, as well as aspects of teamwork, learning attitude, and innovative thinking.

Engineering Practice. Assessment of inspection reports requires the reports to have a complete structure, standardized format, and focused content. It should also reflect an understanding of the examined traffic management system and business requirements, including the system's functions, architecture, and practical applications.

Scientific Paper Writing. The writing of scientific papers aims to train students in the innovation, logical thinking, and academic writing skills required for scientific research. Key points of assessment include the degree of innovation in research content, feasibility of the research plan, logical structure of the article, rigor of language expression, quality of writing, alignment of title and content, expression skills of text and charts, as well as the logical structure of the article.

Results Presentation and Defense. For the assessment of comprehensive analysis training and engineering practice, a results presentation format is adopted. Each group arranges representatives for presentations, and all group members are required to answer questions from the instructor and other randomly selected groups. This aims to stimulate overall participation, integrate into classroom learning, promote thinking, and facilitate communication. The main evaluation criteria for presentations and defense include the logical coherence of the report, the appropriateness of the duration of the PowerPoint presentation, the liveliness of the demonstration, the precision of the defense, and the understanding of the key points of the report in different scenarios. Additionally, discussions and teacher comments are vital for implementing Outcome-Based Education (OBE) teaching. On one hand, it trains students in the ability to comprehensively apply learned knowledge to solve practical business problems. On the other hand, through discussions and comments, teachers can more accurately identify and guide corrections for issues that arise in the students' learning process.

7. Practical Effects and Recommendations

The proposed teaching model has been preliminarily implemented in the 2021 cohort of undergraduate students majoring in Traffic Management Engineering at our institute, yielding positive results. Firstly, through engineering practice, students gained a deeper understanding of the work they may engage in within their professional field, significantly boosting their enthusiasm for learning the course. Secondly, students took on leading roles in teaching activities, not only honing their ability to independently analyze and solve problems but also deepening their comprehensive understanding of the course theory and practice. Lastly, through comprehensive analysis training and engineering practice, students learned to approach problems from a practical standpoint, relying on teamwork and thinking from the perspective of traffic managers. This is highly conducive to cultivating professionals in the field of public security traffic management with innovative spirit, independent thinking, and strong practical abilities.

However, there were some challenges in the specific implementation: Firstly, the total number of course hours is 32, whereas a grade of Traffic Management Engineering majors

consists of approximately 240 students divided into six squads. A good training effect is usually achieved with small group training models of around 40-50 students, but implementing small-group training would consume a significant amount of course hours. Secondly, the course practice also requires students to dedicate a considerable amount of extracurricular time to complete practical content. The use of a combination of online and offline methods for post-class group guidance and Q&A has some impact on the overall practical effect. Thirdly, regarding engineering practice, the current close collaboration is mainly with public security traffic management departments. Expanding collaboration with relevant traffic technology companies could broaden students' horizons and achieve better engineering practice results. Fourthly, even in the teaching process for third-year students, it was observed that some students have not learned basic database operations such as Access and SQL, and even lack familiarity with basic Excel operations. Students need to self-learn these skills in their spare time, affecting the smooth progress of the practice.

To address the mentioned issues, it is recommended to enhance the arrangement of course hours and improve the construction of experimental training venues. Setting up prerequisite courses for relevant Office software and databases, offering related software and programming language elective courses, and strengthening school-industry collaboration can contribute to a collaborative education approach. This would encourage students to value practical experience and prompt instructors to place greater emphasis on practical teaching, enrich teaching methods, and effectively improve teaching quality and effectiveness.

8. Conclusions

The "New Engineering Education" places higher demands on the training of specialized talents in public security traffic management, requiring urgent reforms in the practical aspects of relevant courses. This study, focusing on the practical component of the "Traffic Information Analysis and Application" course in the Traffic Management Engineering major at the Guangdong Police College, proposes a more comprehensive and in-depth reform and design scheme. The presented model is an initial and innovative attempt to reform the practical components of the course in the context of the "New Engineering Education." The aim is to better align course instruction with the new concepts of talent cultivation in the "New Engineering Education" and meet the practical needs of training professionals in public security traffic management. Additionally, this course reform proposal may serve as a reference for the practical teaching reform of other foundational or related major courses.

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