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Research on Teaching Reform of Road Survey and Design Course under Digital Background

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Abstract: As a core course for civil engineering majors, the road survey and design course needs to be innovated and reformed in line with the digital era to enhance both teaching quality and student learning outcomes. This paper analyzes the current teaching status of the road survey and design course and explores strategies for its reform under the digitalization context. The aim is to provide useful insights for educators in effectively delivering road survey and design instruction.

Keywords: Digitization; Teaching model; Teaching reform

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1. Introduction

With the rapid advancement of information technology, digitization, intelligence, and green development have emerged as key trends in the field of road survey and design. These developments place new demands on road survey and design education in colleges. In response, educators should shift their teaching concepts, innovate digital teaching models, and implement reforms in the road survey and design course. This approach will not only enhance students' professional skills and knowledge but also cultivate road survey and design professionals who are proficient in applying digital technologies

2. Overview of road survey and design course

Road survey and design is a highly theoretical and practical engineering course with its teaching content involving road survey, design, and other links. The road survey and design course aims to equip students with fundamental theoretical knowledge and practical skills in road engineering survey and design, enabling them to independently complete the preliminary design of road alignments and construction drawings [1]. In addition, the course of road survey and design also emphasizes design practice and application. During teaching, teachers use case analysis, course design, field survey, and other teaching modes, so that students can combine

theoretical knowledge with practical engineering and improve their ability to solve practical problems with their professional knowledge and skills. At the same time, teachers should also pay attention to cultivating students' spatial imagination ability, innovative thinking ability, and teamwork ability. With the development of education information technology, network teaching mode has become an important way to support vocational teaching work. The traditional teaching model for the road survey and design course no longer meets the needs of contemporary students or the evolving demands of road survey and design development. Digital teaching not only provides rich learning resources but also helps students better understand and master complex engineering concepts and technologies through intuitive and visual methods [2].

3. Current teaching status of road survey and design courses

3.1. The teaching content is varied and the class time is limited

The course of road survey and design includes many aspects such as road engineering planning, survey technology, design methods, norms, and standards with the teaching content being relatively extensive. However, in many colleges and universities, the class schedule for this course is often limited, making it challenging to cover all the necessary knowledge points within the available class time. As a result, teachers cannot explain every knowledge point in depth in the teaching process and students cannot fully grasp the course content of road survey and design in limited class hours [3]. In the long run, this may affect the students' construction and understanding of the road survey and design knowledge system. The course of road survey and design has 32 class hours, all of which are theoretical hours. The limited class hours increase the difficulty of students' learning to some extent.

3.2. The teaching of the course is not closely related to the practical application

Road survey and design is a highly practical course, but part of the teaching content still focuses on theoretical explanation and demonstration by teachers. This approach may lead to students needing to relearn practical skills when they enter the workforce, which could hinder their career development [4]. At the same time, the disconnection between teaching and practical application will also weaken students' interest and enthusiasm in learning. Monotonous theoretical learning and repetitive operational exercises can not only make students wary of challenges and resistant to road survey and design but also hinder the development of their innovative thinking and problem-solving skills in real-world situations. Additionally, the disconnect between road survey and design course content and practical engineering may cause students to only grasp the theoretical aspects of the industry, without gaining a deeper understanding of real-world engineering operations, industry standards, norms, and market demands.

3.3. Limited use of digital teaching software

With the extensive application of information technology in road survey and design, it is also necessary to introduce digital teaching resources to support the teaching of road survey and design courses in colleges and universities. However, some colleges and universities have the problem of insufficient or delayed updating of teaching resources, which makes it difficult to meet the learning needs of students [5]. Thus, the development of teachers' teaching activities and the choice of students' learning methods are restricted, resulting in the teaching effect being affected. The slow updating of teaching resources may expose students to outdated knowledge and skills that no longer align with current industry needs. As a result, students may struggle to address practical

problems in the future, feeling uncertain and unable to solve issues quickly and accurately. The road survey and design industry places high demands on students' digital software application skills, requiring proficiency in tools like CAD, GIS, and other design software. If digital teaching software is underutilized in the curriculum, students may fail to acquire these essential skills, which could negatively impact their competitiveness in the job market.

3.4. The course evaluation method is relatively simple

At present, the evaluation system of road survey and design courses in some universities still focuses on the evaluation of theoretical knowledge and lacks a comprehensive evaluation of practical ability and comprehension quality. This imperfect evaluation system may cause students to pay too much attention to the study of theoretical knowledge, but neglect to improve their practical ability and comprehensive quality. The traditional evaluation method for road survey and design courses often emphasizes testing students' theoretical knowledge through fill-in-the-blank, multiple-choice, and short-answer questions, mainly assessing their grasp of basic concepts. However, road survey and design courses should focus on developing students' ability to apply theoretical knowledge to practical projects. A single evaluation approach cannot fully capture students' practical skills and overall ability [6]. In addition, simple written and practical exams are not able to evaluate students' design ideas, innovation ability, teamwork spirit, etc., which is not conducive to the overall development of students.

4. Teaching reform strategy for road survey and design courses in the digital age

4.1. Optimize the course system of road survey and design

In the digital age, optimizing the course system of road survey and design is the key to improving the teaching quality and cultivating high-quality engineering and technical personnel. To achieve this goal, teachers can reform and improve the course from several aspects. First, in the digital age, the abundance of information resources offers new possibilities for teaching road survey and design. By integrating resources both within and outside the school, teachers can create a blended learning platform that combines online and offline methods, providing students with more diverse learning opportunities and hands-on experiences. For example, the introduction of online courses, virtual labs, and simulation design software, among others, enables students to contact and understand the latest technology as well as the theory of road survey and design in a wider scope.

Secondly, road survey and design is a highly practical course, so it is crucial to emphasize the integration of theory and practice when optimizing the course structure [7]. Teachers can introduce real-world projects into the teaching process, allowing students to analyze specific road survey and design cases. This not only enhances their understanding of the industry but also strengthens their problem-solving abilities. Additionally, teachers can organize key concepts of the course into a systematic knowledge framework. By utilizing the knowledge graph feature of smart course platforms, the integrated knowledge of road survey and design can be imported, showing the relationships and connections between knowledge points at various levels. This will provide students with a more intuitive way to understand and learn the course content. As the field and course evolve, it is important for teachers to regularly update the knowledge map to ensure its accuracy [8].

In addition, quality education cannot be achieved without excellent teachers. Therefore, establishing and improving the teaching staff is another important aspect of optimizing the course system of road survey and design. Colleges and universities should focus on enhancing teacher training and support, encouraging faculty to engage in academic research and professional development. Additionally, inviting industry professionals with practical experience to participate in teaching can help improve the relevance and foresight of the curriculum,

ensuring it aligns with real-world industry needs.

4.2. Strengthen practical teaching of road survey and design courses

Strengthening the practical teaching of road survey and design courses is of great significance for improving students' practical operation ability and engineering practical ability. At present, there is a problem of disconnection between theory and practice in the teaching of road survey and design courses in some universities, which makes it difficult for students to effectively apply what they have learned to practical engineering.

In this regard, teachers can begin by incorporating more field investigations and on-site teaching opportunities, allowing students to engage directly with real-world projects and gain practical experience in the field. Organize students to visit advanced road construction projects or survey equipment, so that students can intuitively understand the whole process of road survey and design, to enhance their interest and understanding of the course content [9]. On-site teaching can enable students to get more practical operation opportunities. For example, teachers can take the classroom outdoors, allowing students to learn the operation and use of instruments such as levels, total stations, and GPS. This hands-on approach enables students to master essential methods of construction surveys, topographic surveys, and control surveys through practical experience.

Secondly, the introduction of a simulation experiment platform is crucial. Colleges and universities should invest in the necessary software and hardware to establish a simulation-based survey and design platform. Through simulation experiments, students can conduct practical road survey and design operations in a virtual environment. This approach not only reduces the cost of experiments but also allows students to perform multiple practice sessions in a safe setting, thereby deepening their understanding of the survey and design processes and their technical requirements.

In addition, teachers can divide students into groups and assign them collaborative tasks for specific road survey and design projects. Through teamwork, students not only develop their communication skills and team spirit, but they also learn how to solve problems in practical projects. This mode can promote students' ability to apply what they have learned to solve complex engineering problems [10]. In addition, universities should regularly invite experts and engineers in the field of road survey and design into the classroom to share their experience and knowledge in practical engineering projects. Such direct exchanges with industry experts can not only broaden students' horizons but also stimulate students' interest in road survey and design careers and improve their professional quality and career planning ability.

4.3. Introduction of digital road survey and design software

With the gradual development of road engineering design and construction in the direction of digitalization and intelligence, the introduction of digital road survey and design software in teaching has become a key step to improve the quality and efficiency of course teaching. This not only helps students master the core skills of modern road engineering design but also stimulates students' interest in learning and cultivates their ability to solve practical problems [11]. Common digital road survey and design software usually include GIS, CAD, and BIM. These tools can provide highly accurate data processing, analysis, visual display functions, and provide powerful support for road design. GIS software can help students to conduct a detailed analysis of the surrounding environment of the road engineering construction site. By collecting, storing, managing, and analyzing the data information on nearby land use, hydrological characteristics, and topography, students can further determine how to design the corresponding road projects.

CAD software is an indispensable tool for road design, which makes the design process more intuitive

and convenient. Students can use CAD software to draw road planning drawings, design detail drawings, and construction drawings, to improve the design efficiency and ensure the accuracy of road design [12]. In addition, the application of BIM technology allows road design to enter a new stage. In actual road survey and design, BIM software can be used to create digital 3D models of road projects. The simulation and optimization of design schemes help students gain a better understanding of complex road engineering structures and enable them to carry out more efficient project management [13]. To effectively integrate these digital software into teaching, colleges and universities should conduct professional training and guidance for teachers. For example, software developers and industry experts are invited to explain the operation methods and application skills of various kinds of software to teachers. Students should also be encouraged to make good use of Internet platforms and online independent learning on platforms such as MOOCs while constantly improving their software operation level.

4.4. Enhance the assessment methods for road survey and design courses

Under the background of digitalization, teachers should also make use of information technology to constantly improve the evaluation methods of road survey and design courses and build a more comprehensive, objective, and scientific evaluation system [14]. First of all, teachers can use platforms such as SPOC to integrate high-quality teaching resources for road survey and design including video tutorials, online tests, virtual practical training, etc. With the help of the statistical function of the platform, students' online learning time, test results, homework submission, and other learning processes can be collected to provide a basis for process evaluation.

Secondly, teachers should innovate and reform the evaluation model [15]. For instance, adopting the '3+1+6' evaluation model can be effective. In this model, a student's semester score is made up of 30% for regular performance, 10% for experimental performance, and 60% for the final exam. Regular performance includes classroom participation, homework completion, and group report quality. In the experimental portion, teachers provide students with the necessary measuring instruments and define the testing environment, requiring students to use survey tools for field measurements and data collection. The teacher graded the students according to their survey methods, data accuracy, and the quality of the experiment report. The final examination is conducted in the form of a closed book and case analysis questions such as line selection and alignment are added to the question types to test students' comprehensive ability of line selection and alignment in practical projects.

Additionally, teachers should place greater emphasis on practice-based assessments. For example, on-site assessments of road survey and design should be incorporated, requiring students to engage in real-world projects and apply theoretical knowledge in practical settings. Students can be evaluated by both the teachers overseeing the practice teams and mentors from industry partners. By implementing these measures, the evaluation method for road survey and design courses will become more scientific, reasonable, and comprehensive, helping students better prepare for the demands of road survey and design work in their future careers.

5. Conclusion

In conclusion, in the context of digitalization, road survey and design instructors in colleges and universities can significantly enhance the quality of their courses by optimizing teaching concepts, enriching teaching resources, and improving teaching methods. This approach will ensure that students not only acquire a strong foundation of theoretical knowledge but also improve their digital literacy, better preparing them for future challenges in the field. The ability to apply survey instruments and design software to solve road survey and design problems

has also been trained, to provide more high-quality road survey and design professionals who are suitable for engineering digitalization.

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