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2026 Volume 4, Issue 4
Contemporary Education Frontiers
ISSN:3029-1879 (Online)
ISSN: 3029-1860 (Print)

Research on the Teaching Reform of Engineering Surveying Course in Private Universities in Zhengzhou under the Background of Informationization

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Abstract: With digitalization and intelligent transformation sweeping across the construction sector in recent years, the matching degree between the teaching mode of engineering surveying courses and industrial development demands directly decides the talent training effect of applied-oriented majors in private colleges and universities of Zhengzhou. Combined with the development features of the local engineering industry and the running characteristics of private institutions, this paper sorts out the current teaching status and existing problems of engineering surveying courses, and puts forward targeted reform schemes suitable for private colleges. The proposed reforms fully highlight the advantages of information technology and keep pace with industrial development. By renovating teaching modes, adjusting course content, reinforcing practical training and optimizing supporting systems, this study strives to realize the deep fusion between course teaching, information technology and professional posts. It aims to lift overall teaching quality and cultivate a group of applied surveying professionals who master modern information technologies and can meet the talent demands of the construction industry in Zhengzhou.

Keywords: Information technology; Zhengzhou; Private colleges and universities; Engineering surveying; Current situation analysis; Teaching reform

Online publication: April 26, 2026

1. Introduction

The engineering surveying industry has undergone tremendous changes as emerging information technologies, including BIM, UAV aerial survey, GNSS positioning, and virtual simulation, have been widely applied in practical work. Traditional manual surveying methods have gradually been replaced by digital, intelligent and high-precision working modes, which set higher standards for practitioners' ability in information operation, data processing and comprehensive technical application. Against this backdrop, exploring the teaching reform of engineering surveying courses in local private universities and building a teaching system compatible with industrial development and school-running reality is of great practical significance. On the one hand, it can improve course teaching quality and talent cultivation efficiency. On the other hand, it helps private colleges form distinctive school-running features, and delivers skilled applied talents

equipped with modern surveying information technologies for local engineering construction, so as to drive the sound and sustainable development of the regional construction industry.

2. The current situation of teaching reform of engineering surveying courses in private universities in Zhengzhou, against the background of informatization

2.1. The integration of informatization teaching is shallow, and the teaching mode is lagging behind

At present, most private colleges in Zhengzhou have realized the important role of information technology in engineering surveying teaching. Nevertheless, the integration of information technology and daily classroom teaching still stays at a superficial level without in-depth application. Most teachers still stick to the conventional lecture-based teaching method. In class, they only use PPT slides and short videos to simply demonstrate the operating steps of intelligent surveying equipment, while lacking systematic explanation and hands-on training for core technologies such as BIM and UAV aerial survey [1]. Some colleges have introduced virtual simulation platforms and online teaching resources, but these resources are not designed according to the practical characteristics of engineering surveying. The separation between online resources and offline classroom teaching makes it impossible to give full play to the advantages of information-based teaching.

2.2. The teaching content is disconnected from industry demands and lacks information technology elements

The digital transformation of engineering surveying has accelerated the iteration of surveying techniques, professional equipment and industrial standards. However, quite a number of private colleges in Zhengzhou still adopt outdated textbooks, leading to slow content update and insufficient involvement of modern information technologies, which fail to keep up with the development pace of the local construction industry. Current teaching content mainly focuses on classic surveying theories and basic instrument operation, such as the use of level gauges and theodolites, as well as the basic procedures of leveling and angle measurement. Related knowledge about BIM modeling, UAV survey, GNSS positioning and survey data processing is either briefly introduced or even excluded from teaching plans. In addition, the course content fails to combine local engineering characteristics, including urban rail transit, urban renewal, and real estate development. The gap between what students learn in class and the actual work requirements becomes increasingly prominent.

2.3. The informatization literacy of the teaching staff is insufficient, and the support for practical teaching is weak

The teaching team of engineering surveying courses in local private colleges also faces many challenges. Most teachers graduated from traditional surveying and civil engineering majors, and have not received systematic training on modern information technologies. Their mastery of BIM, UAV aerial survey and virtual simulation is insufficient, which restricts the implementation of high-quality information-based teaching [2]. Some teachers have basic knowledge of information technology but lack on-site engineering experience. They cannot fully understand the practical application of intelligent surveying technologies in local construction projects, so it is hard to combine real industrial cases and technical application scenarios into classroom teaching.

Restricted by insufficient funds and staffing arrangements, private colleges struggle to recruit professional talents with rich industrial experience in information surveying. The number of teachers with both professional teaching ability and practical work experience is relatively small. Meanwhile, the existing training system for teachers' information capability is imperfect. As a result, the overall information literacy and practical skills of teaching staff cannot satisfy the requirements of curriculum reform.

3. Teaching reform strategies for the engineering surveying course in private universities in Zhengzhou, in the background of informationization

3.1. Integrating technology into the curriculum, constructing a "online + offline + virtual" three-dimensional collaborative teaching model

3.1.1. Build a customized online teaching platform to achieve precise teaching empowerment

Students in private colleges generally pay more attention to practical skill training and have clear learning objectives, while the practical orientation of engineering surveying also determines that traditional online teaching modes cannot meet learning demands. For this reason, building a tailor-made online teaching platform is an effective way to realize refined teaching. The platform integrates diverse teaching resources, including courseware for information-based surveying technologies, equipment operation videos, industrial practical cases, virtual simulation modules, online quizzes, and interactive Q&A sections. Hierarchical learning materials are set for different knowledge points to match students at different learning levels [3]. Besides, interactive communication modules are added to the platform. Teachers can assign learning tasks, correct homework and answer questions in real time; students can upload practical operation videos and share learning experiences. In this way, a complete teaching chain featuring teacher guidance, student-oriented learning, online interaction and offline practical training is formed.

Taking the engineering surveying course for civil engineering majors in a local private college as an example, the school built a dedicated online teaching platform. The platform incorporates typical local engineering cases, including surveying work for Zhengzhou rail transit projects and topographic mapping of urban residential areas, and uploads teaching videos about UAV operation and GNSS data processing.

In the teaching of leveling measurement, teachers release preview tasks on the platform in advance. Students watch equipment operation videos and theoretical courseware, and finish online preview tests independently. In offline classrooms, teachers focus on explaining difficult points and organize students to carry out field operation training. After class, students upload their practical operation videos to the platform for teachers to check and comment. For students with non-standard operations, the platform provides one-to-one targeted guidance and pushes supplementary learning materials accordingly.

3.1.2. Introduce virtual simulation technology to create immersive practical teaching scenarios

The application of virtual simulation technology can create diversified and immersive practical teaching environments, making up for the limitations of offline field training and helping students improve their ability to operate intelligent surveying equipment. Combined with the actual development of engineering projects in Zhengzhou, colleges can develop virtual simulation systems adapted to local construction scenarios, covering urban topographic mapping, rail transit layout setting, building settlement observation and other typical work contents.

The system simulates the whole working process of UAV aerial survey, BIM modeling and GNSS positioning. Students can finish data collection, processing and result output in the virtual environment to consolidate professional skills.

A private college in Zhengzhou combined local urban renewal projects and launched a virtual simulation system for engineering surveying, and developed a simulation scenario for topographic mapping of old urban communities. The system fully reproduces the whole process of UAV data collection, GNSS positioning and mapping data processing. In class, teachers first explain the basic principles and operation specifications of UAV aerial survey, and guide students to select old communities in Zhengzhou as the simulation objects. Students complete UAV route planning, data acquisition and image processing in the system. The platform gives real-time feedback on flight deviation and data accuracy, so students can adjust operating parameters in a timely manner.

After virtual training, students will go to actual old communities to carry out offline practical work. They apply the skills learned from virtual simulation to real work, compare the differences between virtual operation and on-site work, and deepen their understanding of information-based surveying technologies.

3.2. Based on the region, optimize the three-dimensional teaching content system of "theory + practice + industry"

3.2.1. Reconstruct the course content modules and integrate the regional industry characteristics of Zhengzhou

The whole course content is divided into three major modules: basic traditional surveying module, core information surveying module and regional engineering application module. The basic module retains the teaching of classic surveying instruments such as level gauges and theodolites as well as relevant basic theories, so as to guarantee students' fundamental professional ability. The core module focuses on modern information technologies, including BIM modeling, UAV aerial survey, GNSS positioning and survey data processing. This part elaborates technical principles, operational norms, and application scenarios in detail to improve students' comprehensive information literacy.

The regional engineering application module is designed based on local construction characteristics such as rail transit construction, urban renewal and real estate development in Zhengzhou. By introducing a large number of practical engineering cases, this module explains the specific application of intelligent surveying technologies in local projects, so as to enhance the pertinence and practicality of course teaching.

In view of the construction demand of Zhengzhou rail transit, the college adds the content of BIM technology application in rail transit layout to the core module. Combined with the construction case of a metro station in Zhengzhou, teachers explain the layout process and data processing methods of BIM, so that students can master BIM modeling and layout skills. In the regional application module, the course introduces topographic survey cases of local real estate projects, expounds the application of UAV aerial survey technology in land mapping, and arranges students to simulate the whole survey process, including data collection, processing, and result sorting.

3.2.2. Implement "project-driven" teaching and strengthen the cultivation of practical abilities

Project-driven teaching takes real engineering survey projects in Zhengzhou as the carrier, and integrates theoretical knowledge, technical operation and industrial application into project implementation. Considering the learning foundation of students in private colleges, teachers select local practical projects with moderate difficulty and high matching degree with course content, such as campus topographic mapping, settlement observation of surrounding residential areas and suburban road survey.

The whole project is divided into five stages: project initiation, scheme design, data collection, data processing and result submission. Students work in groups to participate in project implementation. During the process, teachers guide students to solve practical problems by using both traditional surveying methods and modern information technologies, including UAV route planning, data accuracy control and BIM model optimization. This teaching mode helps cultivate students' team cooperation ability, problem-solving thinking and on-site operation skills [4].

A local private college takes campus topographic mapping as a practical project. Students are divided into six groups with 5 to 6 members in each group, and clear job responsibilities are assigned to every member. At the initial stage, each group works out a mapping scheme according to the actual terrain of the campus, determines survey scope and technical methods, and selects intelligent equipment such as UAVs and GNSS receivers. In the data collection stage, groups use UAVs to collect ground image data and adopt GNSS technology to complete control point measurement. In the final stage, students use professional data processing software to sort out collected data and draw campus topographic maps, and submit final results.

Teachers provide full-process guidance during project implementation. When groups encounter difficulties, teachers lead students to analyze causes and find solutions. After the project ends, each group presents its achievements, and teachers organize a collective evaluation to select excellent works.

3.3. Enhance teacher capabilities and improve the three-dimensional teacher development system of "training + recruitment + cooperation"

3.3.1. Conduct customized teacher training to enhance teachers' information literacy

Building a targeted teacher training mechanism is the key to improving teachers' information teaching ability and practical working skills. All training contents are formulated according to the industrial development trend of Zhengzhou and actual teaching demands to ensure targeted effects [5]. Colleges can cooperate with local surveying enterprises and peer universities, and invite industrial experts and technical backbones to carry out special training. The training focuses on the practical operation skills and latest development trends of BIM, UAV aerial survey and GNSS positioning. Meanwhile, colleges organize teachers to participate in information teaching training and virtual simulation teaching training, so that teachers can learn advanced teaching concepts and teaching design methods.

For instance, some private colleges have carried out joint training with local enterprises, including Henan Qindar Surveying Service Co., Ltd. and Guangzhou Nanfang Surveying Technology Co., Ltd. Enterprise technical personnel explain the operation procedures and practical cases of UAV survey and BIM layout, and organize teachers to take part in hands-on training to ensure all teachers can skillfully operate UAV equipment and BIM software. In addition, teachers are arranged to visit Zhengzhou Metro construction sites for on-site learning, participating in construction layout and settlement observation to accumulate practical experience. After training, teachers integrate newly learned technologies and industrial cases into classroom teaching. When explaining construction survey knowledge, they combine metro construction cases in Zhengzhou to elaborate on the application of BIM technology, which effectively improves the practical value of teaching.

3.3.2. Deepen the cooperation between universities and enterprises, and build a "dual-teacher and dual-skilled" teaching team

Colleges can establish long-term and stable cooperative relations with local surveying and mapping enterprises as well as construction enterprises. Enterprises' technical experts and senior practitioners can be hired as part-time teachers, who undertake the teaching work of information surveying technology and practical training courses. They share front-line practical experience and technical application skills with students.

At the same time, regular teaching exchanges and joint project research are carried out between full-time teachers and part-time teachers. The two sides jointly compile teaching content, develop teaching resources, and guide students to complete practical training. This cooperation realizes mutual promotion: full-time teachers enrich practical experience, and part-time teachers improve teaching ability.

Many local colleges have in-depth cooperation with enterprises such as Henan Zhonglai Hengchuang Technology Co., Ltd. and Lingbao Gold Group Co., Ltd., and employ eight professional technical experts as part-time teachers, including three experts engaged in UAV survey and BIM modeling and two experts specializing in survey data processing. Combining local engineering projects, such as industrial park terrain mapping and bridge construction measurement in Zhengzhou, part-time teachers explain the practical application and operation skills of information surveying technologies and organize students to conduct field training.

Full-time and part-time teachers jointly develop the special course "*Engineering Surveying in Zhengzhou Region*," develop practical teaching cases and virtual simulation teaching resources, and guide students to finish comprehensive practical projects together.

4. Conclusion

To sum up, this research combines the actual running situation of private colleges and regional engineering development characteristics of Zhengzhou, and puts forward a set of feasible reform measures for engineering surveying courses. The reforms promote the deep integration between information technology and course teaching, improve teaching quality and

talent training level, and help local private colleges create distinctive majors. Meanwhile, the reforms can continuously deliver high-quality applied talents proficient in modern information surveying technologies for regional construction.

It should be noted that curriculum reform is a long-term and continuous improvement process. In the follow-up work, colleges need to keep optimizing teaching modes, updating teaching contents and strengthening faculty construction, so as to further enhance the effect of teaching reform and promote the high-quality development of engineering surveying teaching in private colleges of Zhengzhou.

Disclosure statement

The author declares no conflict of interest.

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