



# Analysis of Teaching Reform of Civil Engineering Surveying Course under the Background of High-quality Development of Higher Education

Minze Li

Oxbridge College, Kunming University of Science and Technology, No.1369, Yunqiao Street (Yunrui Road), Guandu District, Kunming City, Yunnan Province, China

64673309@qq.com

**Abstract.** Facing the strategic demand of high-quality development of higher education in the new era, engineering surveying, as a highly practical core course in civil engineering majors, is urgent to improve its teaching quality through teaching reform. In view of the existing problems in engineering surveying curriculum, such as lagging equipment update, traditional teaching methods and separation of theory and practice, this paper puts forward a series of reform measures such as optimizing curriculum structure, innovating teaching means, strengthening practical links and deepening school-enterprise cooperation. The aim is to explore a new teaching method adapted to the trend of intelligent and digital, and provide reference for the teaching reform of engineering surveying course.

**Keywords:** High-quality development of education; Engineering survey; Teaching reform; Practical teaching

## 1 Introduction

With the promotion of the Outline of the Plan for Building a Strong Education Country (2024-2035), higher education should take "high-quality development" as the core goal and emphasize the cultivation of practical ability and innovative thinking<sup>[4]</sup>. As a key discipline of national training and construction of talents, the professional curriculum of civil engineering is related to the development of the whole discipline, and the engineering survey course is directly related to the cultivation of students' professional skills and engineering quality. However, the current teaching still faces many challenges, and it is urgent to explore the student-centered and practice-oriented teaching reform path. Teaching status quo and problem analysis of engineering survey courses.

## 2 Teaching Aspects

**Teaching content and class hours are limited, and the proportion of traditional content is too large.** Due to the limitation of professional courses, engineering surveying courses can only be used as one of the required courses for civil engineering majors, so it is necessary to quickly cover a large amount of content within the limited class hours. As a result, engineering surveying courses mainly teach traditional surveying theories and methods. For example, the basic level, Angle and coordinate measurement occupy a large number of class hours, but with the development of modern technology, the proportion of curriculum needs to be adjusted. New measuring equipment such as RTK, UAV and 3 D laser scanner are mentioned, but not discussed in depth, leading to the lack of understanding of cutting-edge technologies and making it difficult for students to adapt to the digital needs of the industry. According to the survey, 80% of the graduates feel that the teaching materials are different from their practical application<sup>[7]</sup>.

**The lag of teaching content update is out of line with the industry demand.** With the progress of engineering measurement technology, in addition to the wide application of GIS and RS, 3 D laser scanning has also been used in building modeling, cultural relic protection, uav mapping in topographic mapping, emergency monitoring and other fields. However, the content of engineering measurement course is not followed up in time, and the textbook updating cycle is long, which makes the teaching content disconnected from the practical application, and it is difficult for students to meet the needs of the industry. The laboratory teaching content is too focused on the traditional measurement methods and projects, and the introduction of modern measurement technology and engineering cases is insufficient. As a result, what students learn is disconnected from the actual needs of the work, which affects them to quickly adapt to the position.

**Lack of innovation in practical teaching.** At the present stage, the practice teaching of engineering surveying laboratory mainly takes verification experiments as the main body, students follow the established experimental steps to carry out the operation, and the space for independent thinking and innovation is very limited.

The experimental project setting is relatively fixed, lack of flexibility and diversity, and it is difficult to fully stimulate students' enthusiasm for learning and innovative thinking. Taking the leveling experiment as an example, students only mechanically repeat the measurement process, and have little opportunity to deeply explore the advantages, disadvantages and innovative applications of different measurement methods.

**Lack of teaching guidance.** Engineering surveying practice teaching requires teachers to have rich practical experience and professional knowledge. However, some college teachers, because of their emphasis on theoretical teaching and lack of practical experience, so it is difficult to deeply analyze and effectively guide the problems encountered by students in the laboratory. At the same time, due to the large number of students, it is difficult for teachers to take into account each student, resulting in some students cannot be answered in time when they encounter problems in practice, which affects the teaching effect.

## **3 Experimental Equipment**

### **3.1 Equipment Aging and Technical Lag**

In the engineering surveying laboratory of colleges and universities, some measuring instruments are used too long, wear and tear, and the measurement accuracy is reduced. These traditional equipment lack automation and intelligence, do not meet the needs of modern high precision, high efficiency measurement. For example, the old model full station cannot obtain and transmit data quickly and accurately when processing a large amount of data, which affects students to learn advanced measurement technology.

### **3.2 Imbalance of Equipment Quantity and Configuration**

Due to the limited number of measuring instruments, students need to use instruments in groups in practice teaching, resulting in reduced operation time and uneven practice opportunities. For example, in the whole station experiment, when each group had more than 3 people in each group, some students could only watch, which affected the practical teaching effect and the cultivation of practical ability. This may also make it difficult for students to operate independently in complex tasks, exacerbating the disconnection between theory and practice.

### **3.3 Lack of Equipment Update and Maintenance Funds**

The substantial funds are needed to purchase new measuring equipment and replace old instruments, such as total stations, levels, GPS receivers, drones, 3 D laser scanners, etc. However, the university experimental funds are limited, especially the engineering measurement laboratory equipment renewal funds are less. In addition, equipment maintenance, repair and parts replacement also require funds. Lack of funds makes it difficult to complete equipment update and maintenance in time, which not only shortens the life of equipment, but also forms a vicious circle.

## **4 The Construction of the Practice Base is not Perfect Enough**

### **4.1 Lack of Practice Bases**

Due to the shortage of funds, insufficient space and policy restrictions, it is difficult for universities to establish a stable and appropriate practice base. As a result, it is difficult for students to get sufficient practical training, and they can only rely on the limited open space in the campus for practical operation, which undoubtedly limits their growth. Due to the great difference between the campus environment and the real engineering site, students cannot exercise themselves in the complex and changeable actual environment, such as the construction site with complex terrain and large construction projects requiring high-precision measurement, so it is difficult for students to accumulate sufficient practical experience.

## **4.2 The Practice Content is Single**

Without a suitable practice base, students' practice content is often limited to simple basic measurement tasks, such as topographic mapping on campus, basic size measurement of buildings, etc.

Lack of comprehensive practice projects closely combined with the actual engineering projects, such as urban rail transit engineering survey, deformation monitoring of large-scale bridge engineering and other complex projects. As a result, the knowledge and skills learned by students cannot meet the diversified needs of practical engineering, and it is difficult to quickly adapt to the complex measurement tasks in the job after graduation.

## **4.3 Difficulties in School-enterprise Cooperation**

The lack of practice bases also reflects the lack of cooperation between universities and enterprises.

On the one hand, it is difficult for colleges and universities to find enterprises that are willing to provide long-term cooperation and provide practical opportunities, because enterprises may face problems such as reduced production efficiency and increased difficulty of safety management when accepting students for internship. On the other hand, universities themselves lack effective university-enterprise cooperation mechanism, which cannot fully mobilize the enthusiasm of enterprises to participate in cooperation, and fail to form a win-win situation with enterprises in talent training and technology research and development, which further hinders the construction and development of practice bases.

# **5 Teachers**

## **5.1 Lack of Practical Experience**

Some teachers of engineering surveying courses in universities focus on theoretical teaching for a long time, but practical engineering surveying experience is relatively poor. In the teaching process, it is difficult to combine theoretical knowledge with practical engineering cases, and cannot provide students with vivid and practical teaching content. For example, when explaining the construction survey, due to the lack of practical experience on the construction site, the teacher's explanation of the construction measurement process and matters needing attention is not deep enough, and it is difficult for students to understand and master it.

## **5.2 Slow Update of Professional Knowledge**

With the rapid development of engineering measurement technology, teachers need to constantly update their knowledge to adapt to the teaching. However, some teachers fail to learn the new technologies and methods in time, and still use the traditional teaching content and methods. For example, they are not familiar with new instruments

and advanced measurement software such as mapping drones and 3 D laser scanner, making it difficult to guide students to practice.

## 6 Assessment Method

### 6.1 Emphasis Theory Over Practice

The assessment method of engineering survey courses in most colleges and universities is mainly theoretical examination, which accounts for a large proportion of the total score, while the practical assessment is relatively small. This assessment method leads students to pay attention to the memory of theoretical knowledge, and ignore the cultivation of practical ability. For example, in the theory examination, although students can learn good results through rote memorization, but in the actual operation link often shows the unfamiliar operation, data processing ability and other shortcomings.

### 6.2 Single Form of Assessment

The assessment form is limited to the written test and the experimental report, and fails to comprehensively evaluate the students practical abilities; practical operation ability, innovative thinking and teamwork ability. For example, in the assessment of experimental reports, they often only pay attention to the format of the report and the accuracy of the data, while ignoring the thinking and innovation of students in the process of practice, which cannot truly reflect the students practical abilities; learning effect and ability level.

## 7 Teaching Reform Path and Practical Strategies

### 7.1 Optimize the Teaching Content and Integrate New Technologies and New Ideas

**Adjust the ratio of traditional and modern content.** Reduce the traditional measurement theory class, increase the modern surveying and mapping technology teaching. BIM, GIS and other digital technologies are introduced, integrated into the course, and GIS, RS, 3 D laser scanning and UAV mapping content are added. Through special chapters, the principle, application and operation of these technologies are explained in depth, so that students can systematically master and improve their practical application ability.

Docking of "two-carbon" strategic needs: increase green mapping, low-carbon construction measurement and other content, to cultivate students' awareness of sustainable development [5]. For example, Chongqing University of Science and Technology has added a module of 'Engineering measurement technology under the background of carbon neutral technology' to the course, aiming to strengthen the integration of environmental protection concepts and technological innovation.

**Update the teaching content in time.** Establish a dynamic update mechanism of teaching content to ensure that teachers can closely follow the new technologies, new methods and new norms in the field of engineering measurement, and update the teaching materials in time. For example, the latest project cases are introduced, such as the application of high-precision measurement technology in large bridge construction and the measurement practice in the development of urban underground space, so that the teaching content can closely follow the actual development of the industry and ensure that the knowledge that students have learned is in line with the actual engineering needs.

## 7.2 Innovate Teaching Methods to Stimulate Students' Subjectivity

**Diversified theoretical teaching methods should be adopted.** ITeaching methods should be diversified, combined with traditional teaching methods, and the introduction of PBL and group discussion. When explaining the measurement error, guide the students to think with cases, and deeply understand the concepts and formulas through group discussion. Use animation, video and other multimedia resources to intuitively display the measurement principle, and enhance the interest and attraction of teaching.

**Combination of case teaching and flipped classroom.** select typical engineering cases, such as bridge deformation monitoring and tunnel penetration measurement, to stimulate students' awareness of active learning through group discussion and scheme design, and promote their transformation from passive learning to active exploration. Southwest Jiaotong University adopts the three-stage teaching of "classroom teaching + virtual simulation + on-site practical operation" to improve students' comprehensive application ability<sup>[8]</sup>.

**Information means assisted teaching.** Auxiliary teaching: using virtual simulation platform; sharing quality education resources through MOOC platform<sup>[6]</sup>. Introduce AI-assisted teaching tools, such as AI intelligent learning partners in Rain Classroom, to assist students in learning, help students to make learning plans, and improve learning efficiency

## 7.3 Strengthen Practical Teaching and Deepen School-enterprise Cooperation and Education

**Build the mechanism of "school-enterprise double mentor".** build a practice base with construction enterprises and measurement equipment suppliers who are willing to participate in the cooperation, hire front-line engineers to participate in course design and practice guidance, and ensure that the teaching content keeps up with the industry dynamic<sup>[8]</sup>. For example, the Second Engineering Bureau of China State Construction Corporation has cooperated with many universities to develop the 'engineering survey actual combat training camp', allowing students to participate in the actual project measurement and significantly improve their job adaptability<sup>[2]</sup>. Southern Surveying and Mapping Company and various schools jointly built practice bases, realizing resource sharing and complementary advantages.

**Promote learning and promote teaching through competition.** Organize students to participate in national measurement skills competition, BIM modeling competition and other activities to stimulate students' sense of competition and teamwork ability. Hunan University of Science and Technology increased the proportion of students winning the competition by 30%, verifying the effectiveness of practical teaching<sup>[7]</sup>.

#### 7.4 Reform the Assessment Method, Improve the Evaluation System, and Pay Attention to the Ability Orientation

**Balance the proportion of theory and practice assessment.** Improve the proportion of practice assessment in the total score, so that the proportion of theoretical assessment is equivalent or slightly higher. Practice assessment should cover experimental operation, practical performance, data processing, problem solving and other capabilities. For example, the practice assessment is divided into multiple parts, such as experimental operation assessment, practice report assessment and practice project defense assessment, to comprehensively evaluate students practical abilities; practical ability. The innovative scheme design can also be included in the evaluation system, and the weight can be allocated to theoretical examination (40%), practical operation (40%), and innovative project (20%)<sup>[3]</sup>.

**Enrich the assessment forms.** Adopt diversified assessment forms, in addition to the written test and experimental report, increase the operation assessment, group project assessment, case analysis assessment and so on. Operation assessment can test students practical abilities; proficiency and standardization of measuring instruments; group project assessment allows students to complete a measurement project in group form to assess their teamwork ability and comprehensive application ability; case analysis assessment allows students to analyze problems and propose solutions, and evaluates students practical abilities; ability to analyze and solve problems.

**Establish a dynamic feedback mechanism.** Through students practical abilities; evaluation of teaching, enterprise feedback, teacher mutual evaluation, continuously optimize the course design<sup>[8]</sup>. Student evaluation can reflect the students practical abilities; acceptance of course content and teaching method and provide teachers with direction for improvement; enterprise feedback can reflect the fit between course and industry demand, help teachers to timely adjust the teaching content and ensure that education and social needs; teacher mutual evaluation can promote the communication and learning between teachers and improve the teaching quality.

## 8 Improve the Level of the Teaching Staff

### 8.1 Strengthen Practical Training for Teachers

Regularly arrange teachers to go to the engineering survey front line for practice, participate in practical engineering projects, and accumulate practical experience. For example, teachers can take winter and summer vacations in surveying and mapping en-

terprises or construction units to participate in the measurement of the project, understand the latest trends and actual needs of the industry, so as to better combine theoretical knowledge with practice in teaching<sup>[1]</sup>.

## 8.2 Promote the Update of Teachers' Professional Knowledge

Teachers are encouraged to participate in domestic and foreign academic exchanges and professional training, and to learn the latest measurement techniques and teaching concepts. The school can invite industry experts to hold lectures and training, to provide a platform for teachers to learn and communicate. At the same time, teachers will be supported in carrying out teaching research and scientific research projects to improve their professional quality and teaching ability.

## 9 Conclusion and Outlook

Under the background of high-quality education development, the civil engineering surveying course should reconstruct the teaching system with "student-centered, technology-driven and practice as fundamental". In the future, we can further explore the deep integration of artificial intelligence, digital twin and other technologies with teaching, build the "intelligence + measurement" course module, and cultivate compound talents to adapt to the industry change.

## Reference

1. Kang Juntao. Research on the practical teaching reform of national characteristic major—Take civil engineering major as an example. Heilongjiang Higher Education Research. (54-58). 2013 (04).
2. China State Construction Corporation Second Engineering Bureau. On the practice and application of the teaching reform of "Civil Engineering Survey". China Journal Network, 2020.
3. Yang Lu, Zhang Wenxue. Thinking and exploration of teaching reform of civil engineering construction courses . Original force document, 2024.
4. The CPC Central Committee and The State Council. Outline of the Plan for Building a strong Country in Education (2024-2035) . China Government Network, 2025.
5. Chongqing University of Science and Technology. Research on the teaching reform of civil Engineering majors based on the "double-carbon" national strategy. Hans Publishers,2023.
6. School of Civil Engineering, Chongqing University. Special Meeting Minutes of "Strengthening curriculum Construction and Promoting High-quality Development". Official website of Chongqing University, 2023.
7. Li Shouke, Yu Jianshida. Case teaching study in civil engineering . Chinese Journal website, 2022.
8. Southwest Jiaotong University. The school of Civil Engineering has taken nine major measures to carry out education and teaching reform and practice . Southwest Jiaotong University News Network, 2024.

**Open Access** This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

