Journal of World Architecture, 2023, Volume 7, Issue 6
https://ojs.bbwpublisher.com/index.php/JWA
Online ISSN: 2208-3499
Print ISSN: 2208-3480

Innovation of Engineering Surveying Course Teaching for Road and Bridge Engineering Technology Majors in Higher Vocational Colleges

Lei Zou*

Chongqing Energy College, Chongqing 402260, China

***Corresponding author:** Lei Zou, 516658558@qq.com

Abstract: Engineering surveying is an important course for road and bridge engineering technology majors in higher vocational colleges. With the advancement of science and technology, engineering surveying technology is also constantly developing, so the theoretical knowledge and professional skills that students need to master are also becoming increasingly complicated. To stimulate the students' interest in learning the course, it is necessary to continuously introduce innovative teaching methods into the course. In this paper, the importance of teaching innovation in engineering surveying courses of road and bridge engineering technology majors in higher vocational colleges and the knowledge system that students need to master are analyzed. Subsequently, innovative strategies are proposed to help improve the students' mastery of engineering surveying.

Keywords: Higher vocational colleges; Road and bridge engineering technology major; Engineering surveying

Online publication: December 26, 2023

1. Introduction

The knowledge system is the core of every course, and this also applies to the engineering surveying course of the road and bridge engineering technology major in higher vocational colleges. The knowledge system that students need to master in this course mainly includes three aspects: level measurement, plane coordinate measurement, and measurement error and data processing. Teachers need to be innovative in their teaching methods to mobilize the enthusiasm and autonomy of students so that the students can better grasp the knowledge system and improve their professional skills.

2. The importance of innovative teaching in the engineering surveying course

In recent years, with the continuous reform of our country's education system, quality education has been increasingly emphasized. Engineering surveying teachers must actively implement the reform of the education system and construct an innovative, diversified, and dynamic curriculum teaching system. To encourage

students to become more active and independent in learning the course, teachers can introduce innovative content and teaching methods, and devote themselves to creating a relaxed and pleasant classroom teaching atmosphere for students. In this way, students will be more enthusiastic about participating in the engineering surveying lessons. Under the guidance of innovative ideas, teachers will continue to improve and perfect the teaching plan of the course, improving teaching efficiency and learning effect. As a result, more road and bridge engineering surveying talents will be produced, which can further contribute to society.

3. Knowledge that needs to be mastered in the engineering surveying course

3.1. Leveling

Leveling involves measuring the height difference between two points on the road and bridge engineering ground through the use of leveling rods and leveling instruments. A level and telescope are also required for this measurement. The core content of this topic for road and bridge engineering students is elevation detail measurement and elevation control measurement. In detail measurement, the elevation and plane position of specific points are measured, while in control measurement, a vertical control network is established. When teaching these two parts of knowledge, teachers can use the case method to help students understand the topic better. Teachers should first help students understand the relationship between detail measurement and control measurement, and then introduce examples of these two measurement techniques through the case method. In this way, students can better understand the application of these two measurement techniques.

3.2. Plane coordinate measurement

For plane coordinate measurement, the earth is generally used as the measurement reference system. When students learn this part of knowledge, they need to focus on understanding and mastering fractional coordinate measurement and plane control measurement [1]. Fractional coordinate measurement is a method of implementing scattered point measurement on the basis of plane control lines. The focus of this measurement method is the selection of fragmentary points. When selecting specific points, it is necessary to comprehensively analyze the surrounding landforms and features. Plane control measurement involves determining the elevation and plane position of control points. Students need to accurately grasp the measurement principle of “from overall to specific, and from control points to detail.”

3.3. Measurement error and data processing

In the measurement of road and bridge engineering, human errors and the accuracy of the measuring instrument might lead to measurement errors. If the error is within an acceptable range, the measurement obtained will still be valid. If there is a large the measured data deviates too much from the theoretical value, it means that there is a significant error in the measurement [2]. Therefore, when road and bridge engineering technology students study engineering surveying, they will need to master measurement error and data processing. When explaining this part of knowledge, teachers need to guide students to make multiple measurements, and then obtain the average measurement value through calculation, so that the measurement obtained will be more accurate.

3.4. Construction measurement

Construction measurement is an important part of the knowledge system in the engineering survey course of road and bridge engineering technology majors in a vocational college. First of all, teachers should help students fully understand the commonly used methods for determining plane points, including the Cartesian coordinate method, polar coordinate method, angle intersection, and distance intersection. Secondly, students

need to accurately grasp the positioning based on several key elements: first, the measurement and recovery of the road centerline; second, measuring and setting points based on construction control piles; third, conducting surveys on roadbed side piles, roadbed slope, and elevation; fourth, the measurement and design of vertical curves. Lastly, students need to be proficient in using various construction measuring instruments. This requires teachers to continuously update the teaching content and introduce cutting-edge construction measurement technology and instruments to their students.

4. Methods of innovation in the engineering surveying course

4.1. Renewing the teaching syllabus

With the advancement of science and technology, various new engineering measurement techniques and instruments have been introduced in road and bridge engineering measurement. Therefore, engineering surveying teachers should pay attention to reforming the teaching syllabus of the course. On one hand, it is essential to sensibly adjust the teaching schedule. Engineering surveying is a highly practical course, and when designing the syllabus, it is crucial to move away from traditional theoretical teaching methods. Adjusting the hours allocated to basic theory and increasing practical teaching hours is key, with an emphasis on cultivating students' practical skills in the field [3]. On the other hand, the teaching materials should be selected wisely because they directly affect the teaching quality of the course. Therefore, teachers in higher vocational colleges should select appropriate teaching materials when innovating the teaching of engineering surveying courses. Besides, the content of the teaching materials should also be updated so that they are in line with the latest advancements in the industry.

4.2. Innovation and reform of teaching content

The teaching content of engineering survey courses needs to be innovative. To achieve that, teachers need to investigate and study the latest measurement methods used in road and bridge engineering surveys and make their lessons applicable to real-life job positions [4]. For example, the teaching content of the engineering surveying course can be divided into three modules. The first module is the general surveying module. The teaching content of this module is some basic surveying knowledge, mainly including distance measurement, elevation measurement, topographic measurement, angle measurement, etc. The second module is the construction measurement module, which guides students to make comprehensive use of the basic measurement knowledge they have learned. The content involves line engineering measurement, bridge engineering measurement, and tunnel engineering measurement. The third module is the new technology application module. This module aims to broaden students' understanding of the knowledge they have acquired and to extensively incorporate various measurement technologies like GPS total stations. This approach enhances students' professional skills, enhancing their employability upon graduation. In addition, when innovating and reforming the teaching content of engineering measurement, teachers also need to pay attention to the development of students' practical skills. The integration of theory and practice will deepen students' understanding of engineering measurement in practice. Through practice, students' comprehensive application ability and innovation abilities are developed, so as to promote the all-round development of students.

4.3. Innovation in teaching methods

In the engineering surveying course in higher vocational colleges, the teaching methods adopted are directly related to the stimulation of students' learning interests and the improvement of teaching quality and teaching efficiency. Therefore, teachers need to pay enough attention to the innovation of teaching methods.

Breaking away from traditional instructional approaches, enhancing the interest and vibrancy of engineering measurement teaching becomes essential. This approach effectively stimulates students' enthusiasm for learning [5]. For example, teachers can promote learning through competitions to create a relaxed and pleasant classroom teaching atmosphere for students. Students can be organized into different groups, ensuring that each group has an equal level of comprehensive strength. Teachers can then assign competition tasks to students, outlining specific scoring standards [6]. Led by the group leader, students within each group will have a clear division of labor, accomplishing project tasks through cooperation and discussion. Ultimately, in the engineering survey project task, the team demonstrating the most accurate survey data and the most standardized operations in each stage emerges as the winner. Teachers should reward the winning group, further incentivizing students to actively engage in engineering measurement project competition tasks. Therefore, promoting learning through competitions not only enhances students' engineering measurement knowledge application ability, and technical skills but also cultivates teamwork awareness and a cooperative spirit. This approach helps students improve their professional skills and overall professional quality [7].

4.4. Innovation and reform of the teaching evaluation system

In the past, the students were usually evaluated through examinations, but written examinations are flawed in a way that they can only reflect students' memory of engineering surveying knowledge. Written examinations do not reflect the students' comprehensive abilities. Furthermore, there is also a lack of a system where students get to evaluate their teachers, resulting in a lack of direction for teaching innovation [8]. Hence, teachers must pay attention to strengthening the innovation of the evaluation system of the engineering surveying course. In addition to evaluating students by means of examinations, it is crucial to incorporate process evaluation. Teachers should encourage students to provide constructive feedback on the teaching methods. Setting clear evaluation indicators and weights reasonably will contribute to a comprehensive assessment [9]. **Table 1** shows the evaluation system of engineering surveying teaching for the road and bridge engineering technology major in a higher vocational college. It includes both the teacher's evaluation of the student and the student's evaluation of the teacher. The former covers the evaluation of the students' theoretical knowledge, practical skills, and comprehensive abilities. It reflects the actual situation of learning, and at the same time contributes to the overall development of students [10]. The latter helps teachers discover problems and areas to be improved in their teaching, which acts as important guidance for teaching innovation.

5. Conclusion

In summary, teachers of road and bridge engineering technology majors in higher vocational colleges should fully grasp the essential knowledge that students must learn in the engineering measurement course. They should bring innovation to the teaching syllabus, content, methods, and evaluation systems to enhance the efficiency of the engineering surveying course. In this way, high-quality engineering surveying professionals can be produced for the betterment of society.

Disclosure statement

The author declares no conflict of interest.

Table 1. Teaching evaluation indicators and weights of engineering surveying courses in a higher vocational college

Student's evaluation of teachers		Teacher's evaluation of students	
Evaluation indicators (40 points)	**Score**	**Evaluation index (100 points)**	**Score**
(1) The realization of teaching objectives	**3 points**	**(1) Students' autonomy in learning**	**15 points**
(i) Comprehensiveness of professional knowledge and skills in engineering surveying	1 point	(i) Ability to learn independently and ask questions	3 points
(ii) Whether the teaching method aligns with the actual situation of the students	1 point	(ii) Ability to think independently and solve problems	3 points
(iii) Whether the values and attitudes align with the requirements of the curriculum	1 point	(iii) Ability to complete classroom training and homework	3 points
2. Handling of teaching materials	**8 points**	(iv) Whether the duration for self-study of engineering surveying courses exceeds one-third of the class hours	3 points
(i) Whether the teaching content is centered on the teaching objectives and whether the amount of content is suitable	3 points	**2. Teamwork spirit**	**15 points**
(ii) Understanding of key and difficult concepts	3 points	(1) Discussion of problems with other students	5 points
(iii) Does the teaching content align with reality?	2 points	(2) Performance of group learning	5 points
3. Teaching methods and teaching process	**21 points**	(3) Contribution to group learning	5 points
(1) Are the topics well introduced and did they catch your interest?	3 points	**3. Inquiry ability**	**10 points**
(2) Are you properly guided in class and are your questions answered?	3 points	(1) Do you ask questions in class and make an effort to analyze those questions?	5 points
(3) Are the teaching evaluation methods and incentives adequate and appropriate?	3 points	(2) Are you able to express your opinions freely and have innovative ideas?	5 points
(4) Are the practical lessons well-designed and well-organized?	3 points	**4. Attendance**	**10 points**
(5) Are the lessons discussable and inspiring?	3 points	**5. Practical ability**	**10 points**
(6) Are modern teaching technologies used?	6 points	(1) Understanding of various engineering measurement techniques	5 points
4. Professionalism of teachers	**8 points**	(2) Completion of practical tasks	5 points
(1) Appearance and attitude of the teachers	2 points	**6. Test scores**	**40 marks**
(2) Whether the language used is clear, concise, and vivid	2 points	(1) Mid-term exam	10 points
(3) Whether the writing on the blackboard is neat and whether there are any errors	2 points	(2) Final exam	30 points
(4) Whether the flow of the lessons is well-designed and whether the class can be well-controlled	2 points		

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