Exploration and Practice of a Hybrid Practical Teaching Mode of Online-Offline Virtual-Real Combination of Engineering Surveying

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Abstract. Engineering surveying is a highly practical professional basic course for non-surveying and mapping majors, and its experimental and internship teaching occupy an important position in the course system. In order to improve the quality of applied undergraduate professional talent cultivation, this paper analyzes the problems existing in the current engineering surveying practical teaching process, builds an online and offline practical teaching platform based on virtual simulation technology, and explores the hybrid practical teaching reform of combining virtual and real. The practical results show that the hybrid practical teaching mode of engineering surveying combined with virtual and real can effectively improve students' interest in practical training and practical innovation ability. Through repeated online practice and offline practice, students' self-learning ability and comprehensive practical ability have been significantly improved.

Keywords: engineering surveying, combination of virtual and real, practical teaching, teaching reform.

1 Introduction

Practical teaching is one of the indispensable teaching links in university engineering education, and it is a necessary link to cultivate students' professional knowledge and enhance their practical innovation ability, which plays a significant role in cultivating college students' practical skills, developing the innovative ability, and enhancing their comprehensive quality. Engineering Surveying is a professional foundation course for some non-surveying and mapping majors such as civil engineering, water supply and drainage science and engineering, architecture, urban and rural planning, engineering management and so on in Wuhan University of Science and Technology. This course is highly practical, and the practical teaching process is an important part of the engineering surveying course. The reasonable construction of its practical teaching system is related to the quality of multidisciplinary undergraduate education. At present, the teaching of engineering surveying in non-surveying and mapping majors focuses on theoretical teaching, ignores the construction of practical teaching platform, which ultimately leads to the disconnection between theoretical teaching and practical teaching and fails to achieve the goal of cultivating innovative talents. In order to overcome the shortcomings of the traditional teaching mode, this paper optimizes the practical teaching resources, improves the practical teaching mode, builds the online and offline virtual and real practical teaching platform based on virtual simulation technology, explores the hybrid practical teaching reform of

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combining virtual and real, stimulates students' initiative in hands-on training, cultivates their ability to innovate and practice independently, and further improves the quality of talent cultivation.

2 Analysis of the current situation of practical teaching of engineering surveying

Engineering Surveying is a course with strong practicability, and surveying experiment and surveying internship are inseparable and important teaching part throughout the course[1]. It plays an important role in integrating theory with practice and consolidating classroom teaching. The quality of practical teaching directly affects the teaching quality of the course. At present, the main problems in the practical teaching of engineering surveying for non-surveying and mapping majors in our school are as follows:

- Limited and outdated practical teaching equipment affects the effectiveness of practical teaching.

There are many majors offering engineering surveying courses at Wuhan University of Science and Technology, and the number of various measuring instruments in the engineering measurement laboratory is limited. The laboratory plays an important role in teaching engineering skills[2].Due to the number of internship students is relatively large, the instruments and equipment cannot meet the needs of daily internships well; moreover, the instruments and equipment are relatively old, and there is often a phenomenon of students changing instruments during the internships. Due to the obsolescence and shortage of instruments and equipment, the practice teaching methods of engineering surveying fall behind the operating mode of production enterprises. Advanced equipment such as drones and 3D laser scanners, which are widely used in production enterprises, are not accessible to students during their school years, resulting in students facing outdated knowledge learned in teaching internships that cannot be applied.

- Limited practical teaching hours.

In the situation where the teaching content has increased due to the development of surveying and mapping technology, while the teaching hours have been continuously reduced due to various reasons, the allocated engineering surveying experimental class hours are very limited, and some majors even do not allocate experimental class hours. Throughout the entire teaching process, students only obtain theoretical knowledge from textbooks, without the opportunity for hands-on operation, and the teaching effect is not ideal. In addition, due to the limited experimental class hours, the experimental projects are limited to the operation and use of conventional measuring instruments, and students do not have the opportunity to operate some advanced instruments, unable to keep up with the rapidly changing pace of modern surveying and mapping technology.

- Internship sites are limited, and the internship time is fixed and the internship is easily affected by the weather.

The internship locations for students each semester are located on campus, and the teacher designates a range for each group. The school is filled with pedestrian and vehicular traffic. In

order to ensure the safety of students during internships, the available internship locations on campus are limited. Due to the crowded internship site and the large number of internship groups, students interfere with each other when they select the control points and measure the angles; Moreover, the school features and landforms are very simple, every year topographic map mapping are the same content, which caused some students to speculate and affected the effectiveness of the internship. In addition, due to the fixed duration of student internships every semester, surveying internship is easily affected by external factors such as weather and epidemics.

3 Reform of practical teaching by combining the real and the virtual

In response to the above-mentioned problems in practical teaching of engineering surveying, based on the existing conditions of the engineering surveying laboratory and relying on the virtual simulation training platform of Southern Surveying and Mapping Company, this project optimizes practical teaching resources, improves practical teaching mode, constructs a practical teaching platform that combines virtual and real, carries out practical teaching that combines virtual and real, establishes a diversified practical teaching system, and improves the quality of talent cultivation.

3.1 Constructing the practical teaching model of combining the virtual and the real

Virtual reality (VR) technologies are actively being incorporated into education, teaching, and training in various application domains[3].Virtual simulation technology can simulate various measuring instruments and scenes, allow students to operate instruments and experience the scene on their phones or computers without going out, achieve an immersive and almost realistic experience[4]. It overcomes the limitations of expensive surveying instruments, complex practical scenes, and objective conditions such as weather, allows students to learn and practice related instruments anytime and anywhere, so as to achieve the goal of preliminary mastery of surveying related knowledge and skills.

The traditional experimental teaching mode of engineering surveying is that all the students are divided into groups of four, and the teacher first tells the students the experimental content and demonstrates the operation of the instrument in the laboratory, and then the students borrow the instrument to practice outdoors[5].Except for the time for the teacher to lecture and demonstrate and the time for the students to borrow instruments to go downstairs to the experiment site, each student usually has only about 20 minutes of practice time, because it is the first time for them to operate the instrument, they spend a lot of time familiarizing themselves with the instruments, and the quality of the experiment is not very good. In order to improve the quality of experimental teaching, this project constructs a virtual-real combination of experimental teaching mode, gives full play to the respective advantages of real experiments and virtual experiments, optimizes and integrates the traditional experimental teaching system, and constructs a new experimental teaching system aiming at cultivating students' engineering practical and innovative abilities. In the new experimental teaching mode, students are the main body, and teachers are the leading role. Students are guided to think, analyze, and operate experiments independently. Students conduct self-learning exercises on virtual simulation platforms for each experimental, and then carry out the actual instrument operation experiments

offline. The virtual simulation platform can break the limitations of experimental teaching time, space, and equipment, and promote students to have a deep understanding of experimental principles, equipment, and operating methods. After completing the experimental tasks on the virtual simulation platform, the field measurement offline can further consolidate the basic knowledge of surveying, strengthen students' practical skills, cultivate their practical hands-on ability, and enhance their teamwork ability and sense of responsibility.

The traditional teaching mode of surveying internship is also based on small groups to complete internship tasks, such as completing large-scale topographic mapping on campus, and completing closed leveling around the lake. Each group selects control points based on the survey area assigned by the teacher, and then complete the plane control survey by traverse measurement method , complete the vertical control survey by the fourth-order leveling method, and then collect detail points and draw topographic maps. Considering the safety of students during the internship, there are limited places for internships, the internship sites are crowded, the internship groups interfere with each other, the internship results are compared with each other, and some students are passive and neglectful of their work, and they only undertake a very single task in their internships, such as holding up the leveling rode or recording the data, resulting in some students still not being clear about the entire process of topographic mapping after completing the internship. After introducing a hybrid practical teaching mode of virtual and real integration, each student has to independently complete the whole practice process of traverse surveying, detail surveying, fourth-order leveling, etc. on the virtual simulation platform, which exercises students' independent thinking and problem solving ability, and on the virtual simulation platform through the image of the realistic three-dimensional scene, students can more intuitively understand the layout of the control points, the selection of detail points, etc., which greatly stimulates the students' interest in exploring. Considering that virtual simulation practice teaching also has certain disadvantages, such as certain differences between virtual and real, not conducive to cultivating students' teamwork and other issues. After the completion of the online practice session, the students then go to the field to carry out surveying internship in groups offline, so as to realize the organic connection and complementary advantages of the virtual and the actual. The basis of offline internship teaching is real environment and real instruments. Through the real field measurement, it can effectively exercise students' practical skills and cultivate their teamwork consciousness[6].

3.2 Improving the practical evaluation system and optimizing the evaluation methods

Traditional internship grades are based on individual student attendance and performance during the internship, group internship handbook scores, and group drawing scores. This assessment method mainly emphasizes the ability of group collaboration to complete tasks, neglects the actual abilities of individual students and insufficient reflection of individual contributions in collective achievements. There is a certain degree of subjectivity in the teacher's assessment of each student's attendance and performance during the internship, especially when several classes participate in the internship at the same time (for example, civil engineering majors in our school have six classes in the internship at the same time every year), due to the fact that there are a large number of internship groups, the site is widely distributed and the number of teachers is limited, it is difficult to make a reasonable evaluation of individual students' performance solely based on the teacher's observation and guidance during the internship process, The teacher cannot guarantee a complete understanding of each student's internship performance during the

internship, resulting in a lack of objectivity in the evaluation of individual student performance during the internship. The new practice evaluation system adopts diversified evaluation methods for students: the evaluation role is diversified, which not only requires teacher evaluation, but also allows students to self-evaluate and evaluate each other[7]; Diversified evaluation methods: introducing experimental preview and admission testing links, strengthening student experimental process management, increasing students' personal virtual simulation experiment scores, and comprehensively consider students' participation in online virtual simulation platforms, including video viewing frequency, clearance frequency, clearance time, etc. The diversified practical assessment system can, to a certain extent, eliminate the phenomenon that some students treate the internship muddle through, improve the serious plagiarism and similarity in the internships, and realize the reasonable evaluation of students' ability.

4 Analysis of the effect of the hybrid practice teaching with virtual and real

In order to analyze the teaching effect of hybrid practical teaching of engineering surveying combined with virtual reality, the author made return visits to the students who participated in the teaching reform through several channels, and conducted a questionnaire survey from the aspects of students' independent learning ability, instrument cognition and operation, participation in the practice process, and practice effect, etc. The results are shown in Table 1.

Table 1. Questionnaire on the effect of the hybrid practice teaching.

Content	Yes	No	Uncertain
Improvement of self-learning ability	90%	5%	5%
Improvement of instrument recognition and operational ability	96%	0%	4%
Improvement of participation in the practice process	98%	0%	2%
Improvement of practical skills	97%	0%	3%
Is the hybrid practice teaching mode effective?	100%	0	0
Do you wish to continue to carry out the hybrid model?	100%	0	0

Through investigation, it is found that students have improved their cognition and operation abilities of instruments through the online virtual practical training exercises. They have basically mastered and understood the entire process of surveying internships, and their learning autonomy has greatly improved. During the offline actual surveying internship, students have become familiar with the instrument operation specifications and observation process, overcome their nervousness, and have a high enthusiasm for the internship. Each team member wants to personally practice each step of surveying practice, and instrument operation is no longer limited to a fixed team member. All team members participated in the entire internship process, and each person took turns participating in each job of the internship.

According to students' feedback, after training on the virtual simulation platform, they have a deep understanding of the measurement steps and instrument operation methods, and they all enthusiastically try the real instrument operation. Under the hybrid practical teaching mode of virtual-real integration, students' interest in participating in practical activities has increased significantly, and their participation in surveying internship has been greatly improved.In a word,

through the practice teaching reform the students' enthusiasm for internships, practical skills, and teamwork skills have been greatly improved. The quality of internship teaching has also been improved.

5 Conclusions

Based on the virtual simulation training platform of Southern Surveying and Mapping, this paper explores the hybrid practical training mode of virtual and real integration for engineering surveying online and offline, and carries out the reform of practical teaching of engineering surveying by combining virtual and real. The virtual simulation training platform breaks through the time and space limitations of traditional practical teaching, guides students to think independently, promotes students' understanding of the measurement process and the operation process of the instrument, significantly improves students' participation in experiments and internships, and further consolidates the theoretical knowledge. Through the hybrid practice teaching reform of virtual-real integration, students' internship enthusiasm, internship participation, practical skills and team collaboration abilities have been greatly improved, and the research in this paper also provides a reference for the practical teaching reform of engineering surveying for non-surveying and mapping majors.

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