Teaching Reform and Practice of Soil Mechanics and Foundation Course Based on "Application + Innovation" Ability Cultivation Mode

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Abstract. Aiming at the educational characteristics and current situation of applied undergraduate universities, a series of reforms and explorations have been carried out on the course "Soil Mechanics and Foundation". Teaching contents are optimized, teaching methods and assessment methods are improved, and engineering applications and innovations are highlighted, which lay a solid foundation for achieving the goal of cultivating high-quality applied innovative talents.

Keywords: soil mechanics and foundation · teaching reform · teaching practice

1 Introduction

Soil Mechanics and Foundation is a compulsory core course for civil engineering students in higher education institutions. The goal of the course is to enable students to master its basic concepts and theories, and have the ability to apply relevant knowledge to solve practical engineering problems.

The course involves several disciplines such as engineering geology, soil mechanics, building structure and construction, with many concepts, large theoretical span and mathematical derivations, which makes it very difficult for teachers to teach. Therefore, in the local universities aiming at cultivating application-oriented talents, how to organize the teaching, achieve the course teaching objectives, and effectively improve the students' engineering practice and innovation ability is an important issue of great practical significance.

2 Problems in Teaching the Course

In recent years, in order to meet the needs of the society and the development of the school, many scholars in china have carried out reform and practical research on the course "Soil Mechanics and Foundation" in terms of teaching concept, content, methods and practical teaching on the basis of traditional teaching [1–5]. The research results focus on the practical teaching reform idea of "student subjectivity, teacher dominance, emphasis on fundamentals, strong application", constantly strengthen the importance of practical teaching in the course teaching, constantly update the new developments and ideas in the industry, constantly improve teaching methods and teaching tools.

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However, there are still many problems in the actual teaching process at this stage. Take the civil engineering course "Soil Mechanics and Foundation" of Haikou College of Economics as an example, the total class hours of this course is 48 class hours, 40 class hours of theory and 8 class hours of laboratory. The theoretical courses are mainly taught in chapter order, while the experimental courses are interspersed with it. Its assessment mainly adopts the mode of usual grade (30%) + final grade (70%). This traditional teaching method and assessment model have major shortcomings: Firstly, due to poor foundation, some students have poor mastery of the application of mechanics-related knowledge. Secondly, as traditional teaching is carried out in the order of selected textbook chapters, the teaching logic is a bit confusing and the knowledge points are not coherent enough. Thirdly, the traditional single teaching mode cannot reflect its application characteristics and is not conducive to cultivating students' innovation ability. Fourthly, the lack of laboratory teaching hours and the "teaching-oriented" method caused students not to pay enough attention. Coupled with the low per capita occupancy rate of equipment, the experimental effect is poor. Finally, too single assessment method emphasizes the results rather than the process, and cannot accurately evaluate the students' mastery of the knowledge they have learned.

3 Reform and Practice of Course Teaching

3.1 Reconstruct the Curriculum

The curriculum is reconstructed in terms of both theoretical and practical teaching. The theoretical teaching part of the course is repositioned according to the Code for the Design of Building Foundation[6], establishing three core modules: soil mechanics module, foundation engineering module, foundation treatment module, and split into several sub-modules according to engineering applications. The reconstruction of practical teaching is divided into in-class and extra-curricular teaching modules. The in-class practical teaching is based on the traditional verification experiments with several new practical training projects, while the extra-curricular practical teaching adopts open experiments to make a better integration of theoretical knowledge and application ability of soil mechanics and foundation courses. The detailed reconfiguration of the curriculum is shown in Fig. 1.

3.2 Reform the Course Content

The original course content is heavy on theory and light on practice, with many and miscellaneous knowledge points, a large amount of theoretical calculations, and a lack of systematic training programs. Therefore, based on the traditional three verification experiments "Density, Moisture Content and Limit Water Content Test", "Consolidation Compression Test" and "Direct Shear Test", we have added nine practical training projects such as "Identification and Naming of Engineering Soil", "Final Settlement Calculation of Foundation", "Discrimination of Soil Stability", "Determination of Foundation Bearing Capacity", "Calculation of Earth Pressure on Retaining Wall", "Reading of Engineering Geological Survey Report", "Independent Foundation Design under

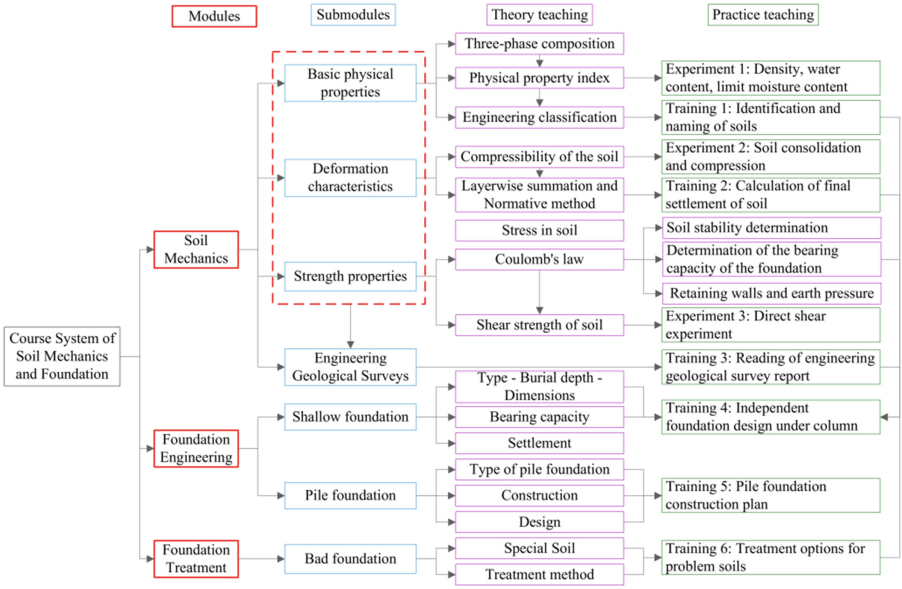

Fig. 1. Reconstructed curriculum

Column", "Construction Plan of Pile Foundation", "Treatment Plan for Poor Foundations", etc. Project-based teaching allows the integration of theory and practice, which can broaden the knowledge and enhance the engineering application ability. At the same time, open experiments are added: "Specific Gravity of Soil Particles", "Compaction of Soil", "Static Load of Soil", etc. Students are allowed to design their own experimental projects to cultivate their creative ability.

3.3 Optimize Teaching Models and Methods

At this stage, students are resistant to learning theoretical courses, not active and motivated enough, not aware of the importance of learning, and appear unwilling to learn or will not apply after learning. In response to this problem, we adopt a combination of online teaching and offline practical training. First of all, the online teaching platform is used to push teaching resources and teaching tasks to students before class, so that students can study independently in advance. Then the knowledge is digested by organizing Q&A, discussions and exercises in the classroom. Finally, the application of knowledge is completed through online tests and offline comprehensive practical training. Most importantly, the comprehensive use of various teaching methods should be emphasized during the instructional phase.

3.4 Innovative Assessment Methods

In order to reduce the proportion of final exam grades and increase the value of process assessment to improve students' motivation, we have changed the assessment concept

Table 1. The innovative assessment methods.

Final marks	1	X			Daily performance
	Final exam	X_1-Module test	X_2-Experiment	X_3-Practice	
100%	40%	10%	10%	20%	20%

and adopted the "1 + X" assessment method. Where "1" refers to the final assessment; "*X*" refers to the additional process assessment according to the specific situation, i.e. $X = X_1 + X_2 + X_3$. The innovative assessment methods are shown in Table 1 below.

The daily performance mainly include attendance, homework and classroom performance, which are automatically scored with the help of online Course management, after-class homework, and attendance management system.

3.5 Explore School-Enterprise Cooperation Mode

Taking school-enterprise cooperation as a platform, the college establishes long-term cooperation mechanism with design institutes and construction enterprises. On the one hand, through the activity of "industry experts in the classroom", industry experts are invited into the classroom to make thematic reports on professional courses for students to enhance the practicality of classroom content and stimulate students' professional interest and enthusiasm; on the other hand, while studying theories, students are taken to construction sites for field observation, so that the classroom content and actual projects are well connected and the openness of teaching content is realized.

3.6 Strengthen Industry-Academia-Research

Based on the foundation of the curriculum and regional engineering geological problems, students are led to participate in innovative and entrepreneurial practice by taking "Student Innovation and Entrepreneurship Project", "Internet +", "Challenge Cup", and "Youth Creation" as the platform, and by relying on teachers' scientific research projects and school-enterprise cooperation projects. Through various indoor experiments and field practice, we inspire students to export their scientific research results and strengthen the transformation of scientific research results.

4 Conclusion

As a basic course of engineering, "Soil Mechanics and Foundation" focuses on the combination of theory and practice. In this paper, reforms are made in teaching contents, teaching methods, assessment methods, etc. Practice shows that the measures of these reforms have played a positive role in strengthening students' basic knowledge, improving computing ability and strengthening practical ability, and the quality of teaching and learning has been significantly improved.

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