

# Research on the development and application of loose-leaf textbooks for soil mechanics

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**Abstract:** The research of this paper aims to develop a new form of a digital textbook for the course of "Soil Mechanics" to solve the existing problems in higher vocational education. The *Soil Mechanics* textbook is out of touch with the actual production of enterprises, and its content is outdated. In order to cultivate students to adapt to the digitization requirements, we have co-developed the loose-leaf textbooks for "Soil Mechanics" in conjunction with front-line companies, which break through the framework of traditional course syllabus and textbooks, emphasizing the work process learning of actual production projects. The textbooks comprehensively consider the educational role of the course in the aspects of knowledge and skills, learning process and methodology, emotions, attitudes and values, and integrate the teaching and implementation process with the work content and knowledge together.

**Key words:** "Soil Mechanics"; loose-leaf textbook; task-based teaching

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## 1 Introduction

The traditional education school represented by the German educationalist Herbart J.F. believes that the value of textbooks lies in their specific content and usage value. Their purpose is to enable students to acquire a wealth of knowledge. The compilation of textbooks is presented in the logical order of knowledge, as a means of influencing the cognitive activities of students, and emphasizing the construction of disciplinary textbook [1]. The American pragmatist educator John Dewey put forward a brand-new concept of teaching material construction in response to the various shortcomings of traditional textbooks, advocating that the construction of textbooks should start from the learners' experience, taking the learners' already existing experience as a starting point, linking new things and events with earlier experience in a rational way [2][3], and advocating the design of comprehensive textbooks and activity textbooks [4][5]. In today's digital era, vocational education textbooks are not only the carrier of school teaching content, but also serve as a guide to workplace processes. In today's higher vocational education, workbook-style textbooks and loose-leaf new textbooks are becoming increasingly popular, with the dynamic open-source form of textbooks to dock the ever-changing industrial and technological changes [6]. Along with the continuous updating and iteration of digital technology, more and more new modes of industry, new forms of business and technologies, new techniques are emerging like a tide. These production processes and job characteristics will be presented to students through scientific and systematic, flexible and elastic project design, and contextualized tasks.

Under the background of digital transformation of industries, the development of loose-leaf textbooks for vocational education is based on the premise of multi-party cross-border cooperation to buttress the digital technological change of industries, guided by the in-depth integration of industry and education, supported by various types of accessible digital resources, led by multi-party synergistic teaching and innovation teams, and carried by new information-based textbooks fully covering the characteristics of job skills, with an emphasis on the cultivation of students' professional and technical skills [7].

## **2 Methodology for the construction of textbooks**

"Soil Mechanics" is an important professional core course for higher vocational education in the group of plumbing and construction engineering, which is a highly applied methodological and technical course for analyzing and evaluating the mechanical properties and mechanical behaviors of the soil from the perspective of engineering construction and is applied to building foundations, underground engineering, and slope engineering.

### **2.1 Workflow-based curriculum framework**

The textbook reconstructs the curriculum framework based on the workflow, splits the work modules into chapters, forms the sequential system of back-and-forth articulation and organic combination, and forms the closed-loop system for docking the workflow, adhering to the concepts of "docking the content of textbooks with vocational standards" and "matching the modules of textbooks with the project flow", so that the textbooks can meet the skills of vocational positions and the industry's technological requirements, and also conform to the general rules of vocational literacy and skills training.

### **2.2 Developing loose-leaf textbooks for "Soil Mechanics"**

Based on the order of workflow, the content of the textbooks is determined on the principle of project orientation and task driven, covering the requirements of job skills. In the process of textbook development, it is necessary to focus on job competence as a landing point to form a diversified cooperation model that includes enterprise professional and technical backbone, vocational college teaching and research course experts, and front-line full-time teachers. The main body of textbook development can follow the development of industries, new technologies, and new businesses, enabling textbooks to transform towards digitization, so that the frequency of the textbook updates is synchronized with the trend of the digital transformation of the professional positions, and the textbook will be student's homework guide.

The textbook closely follows the development trend of the industry and industry talent demand. It is necessary to timely incorporate new technologies, processes, and standards of industry development into the content of textbooks, reflect the professional ability requirements of typical positions (groups), and deeply involve industry enterprise technical personnel, skilled craftsmen, and others in textbook writing. Since 2002, China's survey and design industry has implemented a registered engineer professional qualification management system, which has been in effect for more than 20 years. Currently, the relevant system is becoming increasingly perfect, playing a crucial role in improving the quality and level of construction engineering survey and design, and regulating the industry market order. To promote the cultivation of professional qualities and professional abilities, in the process of writing this textbook, standard specifications related to the knowledge points involved in the practice of registered civil engineers (geotechnical engineers) have been introduced, such as the *Code for Geotechnical Engineering Survey*, *Code for Design of Building Foundation*, *Technical Code for Building Slope Engineering*, etc. The content of each project in the textbook is closely related to the actual engineering needs, and is also connected to the professional qualification examination for registered civil engineers (geotechnical engineering) in the People's Republic of China.

### **2.3 Supporting the development of electronic resources**

The textbook creates teaching situations with actual engineering projects, embeds real typical application cases in the textbook, and produces learning micro-lesson videos and online learning resources. It allows for targeted gap-finding and targeted training, integrating various forms of textbooks to enhance the learning experience of students. For example, the students in the process of learning based on the textbook can also find their own knowledge and ability of the relatively weak links.

### **3 Recommendations for the application of the textbook**

This textbook is based on the requirements of vocational job skills, combined with the typical work tasks in this industry. The textbook content is modularized into the "physical properties of soil and engineering classification", "soil permeability and seepage problems", "stress in soil", "deformation characteristics of soil and foundation settlement calculations", "shear strength of soil", "soil pressure on retaining structures", "soil slope stability analysis", "foundation bearing capacity" of a total of eight projects. Typical engineering cases are introduced into the course content, with the cultivation of ideals and beliefs as the fundamental goal, the cultivation of civic literacy as the basic goal, and the cultivation of professional qualities as the vocational goal.

#### **3.1 Intensive vocational skills training**

Combined with real project cases in the teaching process, students have achieved the quality, knowledge and ability goals in the project based on the real work process and strengthened the vocational skills. The sand table model in the geology museum guides students to recognize various engineering activities, and the simulation training platform is used in the smart classroom to simulate various engineering construction processes, and the field practice focuses on students' hands-on ability and their ability to analyze and solve problems in practice.

#### **3.2 Multi-dimensional evaluation of the learning process**

The evaluation quantitative table and learning platform are used in teaching to collect students' learning information in the whole process, automatically generate evaluation information, and form real-time feedback, so that teachers and students can adjust their teaching and learning behaviors in a timely manner. Through this method, student satisfaction, the correct rate of post-course tests and the completion rate of practical training tasks are significantly improved. In the process of teaching, students can feel teacher's intention, so that they can enhance their interest in learning and can enjoy learning. After the reform of project-based teaching, students' sense of identity and pride in their majors have greatly improved, and all of them can pass the skill attainment standard.

#### **3.3 Teaching strategies**

Through case studies in classroom and teacher demonstrations, the importance, professionalism, and sense of professional responsibility of the fundamentals of geotechnical engineering are emphasized. Firstly, it is advisable to integrate the curriculum resources to realize the application of a comprehensive classroom education platform, and achieve and ensure the comprehensiveness of the application of various types of materials based on the requirements of the educational content of the discipline. Secondly, a combination of online and offline teaching methods should be adopted to ensure that key points, doubts, difficulties, and engineering cases are taught in the classroom, and allow students to engage in discussions and interactions to stimulate their learning interest and initiative. Thirdly, experimental courses are set up for students to operate the experiments, deepen their understanding and mastery of theoretical knowledge, and cultivate their independent thinking and practical ability. Next, new technologies such as numerical computation and numerical simulation can be introduced into the teaching, so that students can understand the latest engineering technology and research progress, and cultivate their numerical computation and problem-solving ability

## Conclusion

The development of this textbook breaks through the framework of traditional syllabus and textbooks, emphasizes the work process learning of actual production projects, and comprehensively considers the educational role of the course in the aspects of knowledge and skills, process and methodology, emotions, attitudes and values. The cooperation between schools and enterprises in developing the loose-leaf textbook for "Soil Mechanics" will truly reflect the integration of engineering and learning through the implementation process of teaching.

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## Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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