Exploration of the School-Enterprise Co-Construction Model for the Course "Preparation of Soil and Water Conservation Plans for Production and Construction Projects" from the Perspective of Industry-Education Integration

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Abstract: Industry-education integration is an important path for cultivating applied talents in the new era. Aiming at the problems existing in the teaching of the course "Preparation of Soil and Water Conservation Plans for Production and Construction Projects", such as the disconnection between theory and practice, teaching content lagging behind industry needs, and students' lack of engineering practice ability, the College of Desert Control Science and Engineering of Inner Mongolia Agricultural University and Inner Mongolia Power Survey and Design Institute Co., Ltd. carried out in-depth cooperation. They built a course model of co-construction with such features as dual school-enterprise directors, full-project penetration, and four-stage scenario progression. The existing opportunity is to effectively integrate the teaching process with the production practice by means of a working school-enterprise cooperative content updating system and simultaneously create a practical enterprise project case library, a multi-scenario teaching approach in the classroom-computer laboratory-enterprise-site, and an assessment and evaluation system in the guidance of enterprise tutors. Practice shows that this model significantly improves students' plan preparation ability and professional quality, providing a reference for the construction of applied courses in similar universities.

Keywords: Industry-Education Integration; School-Enterprise Cooperation; Soil and Water Conservation Plan Preparation; Course Construction; Teaching Reform

1. Introduction

Regarding the Chinese educational reform, the further industrialization of education has been listed as one of the key directions of developing high-quality applied engineering laborers [1]. Under this scenario, the intimate relationship between industry and education has been viewed as the central theme of the higher education reform. In particular, the interrelation between school and companies to offer engineering education is an important mechanism to ensure the last level of the talent development [2]. Soil and Water Conservation Plan Development in Production and Construction Engineering is one of the initial elective professional courses provided in the Major of Soil and Water Conservation and Desertification Combating. The course has some distinctive features, such as the high level of integration between practice and requirements based on the statute, cross-disciplinary overall knowledge structures, and the dynamism and variety of application environments [3]. It is necessary to have an organized body of knowledge and awareness about laws, regulations, and technical standards and be able to come up with standard project plans by oneself, which is particularly important considering the needs of the industry. Nevertheless, in the conventional education system, the curriculum changes are done at a lower rate compared to the changing standards of the industry, the cases used in teaching and as case studies do not refer to current projects but

to outdated projects that are found out of the region, and the students will not ever have the opportunity to experience the authentic engineering environment, and it will result into a universal trend of having what is widely discussed as inadequacy after graduation and entering the working life [4].

Inner Mongolia Power Survey and Design Institute Co., Ltd. is one of the biggest companies in the area of soil and water protection in the field of power engineering in the autonomous region, which has been engaged in developing projects and special design documents of major projects including UHV transmission lines and giant new energy bases. School-enterprise cooperative course co-construction program between the College of Desert Control Science and Engineering of the Inner Mongolia Agricultural University and this company began in 2025. In collaboration with the course director at the school Professor Guo Yuefeng and the enterprise-side course director, Senior Engineer Huang Jianguo, the project analyses the four main dimensions in a systematic way: the reconstruction of course contents, the innovation of teaching models, the creation of the practice platforms, and assessment and evaluation modifications. The paper generalizes the overall structure, implementation, and time effectiveness of the school-enterprise co-construction model of the course as an overview of the general scheme that can be applied to create other industry-education integrated courses in other universities with the same characteristics.

2. Realistic Dilemmas Faced by Traditional Course Teaching

Combining course characteristics and industry employment feedback, traditional teaching mainly faces the following three dilemmas.

2.1 Lack of Industry Forefront in Course Content

The preparation of soil and water conservation plans involves a multi-level system of laws, regulations, and technical standards, such as the Law of the People's Republic of China on Soil and Water Conservation, the Technical Standard for Soil and Water Conservation of Production and Construction Projects (GB 50433-2018), and the Guidelines for Calculation of Soil Loss from Production and Construction Projects (SL773-2018), and industry norms are updated frequently [5,6]. However, the revision cycle of traditional textbooks is long, and classroom teaching content often lags behind the pace of standard updates. Taking the SL773-2018 guidelines as an example, this standard, released in 2018, unified the three-level classification system and standardized calculation process for soil loss under hydraulic and wind forces. Yet, many university courses still use the empirical analogy method as the main teaching tool, and students lack a systematic mastery of these guidelines [7]. In addition, teaching cases mostly come from humid eastern regions, providing insufficient coverage of the regional characteristics of wind-water composite erosion in Inner Mongolia, making it difficult to cultivate applied talents who can "stay and be useful" locally [8].

2.2 Disconnection between Practical Teaching and Real Enterprise Scenarios

Although the course includes practical components, they are mostly simulated projects on campus. Students cannot access original engineering documents such as real topographic maps, excerpts from feasibility study reports, design drawings, and review opinions. The course is dominated by teachers' classroom lectures, with insufficient teacher-student interaction and a clear tendency to "value theory over practice." However, industry positions require students to independently complete investigation, calculation, design, and plan preparation work in complex environments such as Gobi deserts and mine sites. Relying solely on on-campus teaching makes it difficult to fully cultivate this core ability [9].

2.3 Weak Occupational Orientation in Assessment and Evaluation

Traditional assessments are dominated by final closed-book exams, focusing on testing the memory of regulatory provisions and basic principles, with insufficient coverage of students' professional core competencies such as plan preparation ability, software operation proficiency, communication, and defense skills. The evaluation subjects are solely on-campus teachers, lacking perspectives and standards from the industry frontline, making it difficult to provide students with authentic feedback on their professional abilities [10].

3. Overall Framework of the

School-Enterprise Co-Construction Course Model

The course has developed a content updating system that uses the standards, cases and problems. First of all, there is the on-the-fly integration of the industry standards: it is necessary to make sure that new technical regulations regarding the soil and water conservation are implemented in the training process as a module on the topic of an interpretation of the standard update (i.e. include the principles of calculations of the SL773-2018 guidelines into the appropriate chapters as soon as possible). Secondly, the list of real projects being carried out by the enterprise is constantly updated: during the teaching process, not less than 2-3 examples of the project of engineering works are provided as penetrating teaching cases, i.e., every year at least one example of the UHV transmission line or large photovoltaic power station is given as a penetrating case study. The case materials consist of the actual maps of topography, feasibility studies reports, designs, and opinions of review. Thirdly, topical lectures on the issues of the engineering frontier and the pain points: the most acute topics of the industry such as vegetation rehabilitation and balance of water resources of the new energy projects, new technologies of protection in the field of the transmission towers in the slopes, etc. will be discussed in the classroom as the technological frontiers and engineering challenges.

4. Implementation Path of the School-Enterprise Co-construction Course

4.1 Establishing a School-Enterprise Collaborative Dynamic Content Update Mechanism

This course has created a content update system that incorporates the use of standards, cases, and problems. To start with, industry standards are integrated on-the-fly: the enterprise wing is to ensure that any new soil and water conservation technical standards and local regulations are incorporated into training in the form of a module on the subject of a standard update interpretation, i.e. incorporate the main calculation rules of the SL773-2018 guidelines into appropriate chapters at the earliest convenience. Secondly, the database of real project cases is being constantly added to: every teaching cycle presents not less than 2-3 common examples of engineering projects (e.g., a UHV transmission line project, a large photovoltaic power station project) that have been or are being implemented by the enterprise in the present year as penetrating teaching cases. The case materials comprise actual topographic maps, extracts of feasibility studies reports, design drawings and review opinions. In the third place, topical seminars on engineering frontiers and pain points: discussing the most burning issues in the industry like vegetation restoration and water resource balance in new energy projects, new protection technologies in the area of transmission tower foundations in steep slopes, the experts of the enterprise are invited to deliver special lectures, turning technological frontiers and engineering issues into topics of the classroom discussion.

4.2 Implementing Multi-Scenario Teaching

Breaking through the limitations of traditional classroom instruction, a classroom + computer lab + enterprise + site multi-scenario teaching mode is adopted. The theoretical teaching on campus adopts smart classrooms, mainly in the form of case introduction and group discussion; the software training is carried out in the professional computer lab, and students use professional software such as CAD, GIS, etc. to analyze data and draw pictures; enterprise on-site teaching organizes students to visit the design department of Inner Mongolia Power Survey and Design Institute to intuitively understand the actual workflow and model of technical document management; field on-site teaching arranges students to go to typical project areas for field cognition and investigation practice. Among the total 40 class hours, practical teaching accounts for 16 class hours, accounting for 40%.

The course also incorporates the systematic application training of the SL773-2018 guidelines in practical teaching. Students are taught how to split disturbance units as per the requirements of the guidelines (general disturbed surfaces, engineering excavation surfaces and engineering accumulation bodies should be categorized into large, medium and small scales depending on the disturbance area/excavation volume/fill volume), find out typical disturbance units (all when the number is less than or equal to 20, and by type and scale when more than 20) and choose suitable calculation formulas according to various loss types including vegetation-destroyed surfaces,

surface-overturned surfaces, engineering excavation surfaces and engineering accumulation bodies [6].

4.3 Constructing a Project-based Teaching Model Guided by "Dual Mentors"

Each semester, the course organizes students into groups of 4-5. Based on simplified real project materials provided by the enterprise, they complete a full-process plan preparation task from data analysis, virtual investigation, measure design, and investment estimation to text compilation. Each group is equipped with "professional teacher + industry mentor" dual guidance. Enterprise mentor Huang Jianguo undertakes 8 hours of practical teaching tasks, focusing on the plan preparation technology and industry review standards for power transmission and transformation and new energy projects. In the core topic of the course—"Design of Soil and Water Conservation Measures for Transmission Line Projects"—a five-step teaching method of "scenario introduction → theoretical elaboration → enterprise expert difficulty analysis → group actual combat → cross-review" is adopted. The teacher first shows photos of engineering site problems provided by the enterprise to guide students in analyzing constraints such as topography, soil, and rainfall; the enterprise expert then deeply analyzes the three major difficulties of earthwork balance, slope stability, and vegetation restoration in steep slope tower foundation soil and water conservation design, and shares innovative practices such as prefabricated retaining walls and ecological bag slope protection; students then design "site-specific" prevention measure sketches on CAD base maps in groups, followed by outcome displays and cross-reviews.

4.4 Promoting a Diversified Assessment and Evaluation System with Deep Enterprise Participation

The course has established a diversified assessment system of "process evaluation + summative evaluation + enterprise evaluation." Process evaluation accounts for 50%, including classroom discussion participation, phased design assignments, and software training outcomes; summative evaluation accounts for 50%, consisting of a final closed-book exam and comprehensive plan preparation. As an important evaluation subject, enterprise mentors deeply participate in the review of practical components. Their evaluation of students' design plans, plan texts, and defense performance accounts for more than 30% of the total course grade, examining the standardization, practicality, and innovation of student outcomes from an industry perspective. In addition, by holding "mock plan review meetings" and inviting enterprise experts to serve as judges, the assessment process itself becomes a high-value professional ability training exercise.

5. Implementation Effectiveness and Reflection

Through exploration and practice, the school-enterprise co-construction course model has achieved phased results.

Students' practical abilities have significantly improved. To the majority of students, the course is practical and fulfilling, and they have become more confident in their ability to solve problems of real-life engineering challenges and have acquired a professional identity. The company has recognized students achievements in design numerous time and some of the most successful group tasks have been used as sources of information in the Young Engineers Ideas Database of the company. Preparation rates of comprehensive plans in actual enterprise projects are greater than 90%. The rate of graduates who join cooperative enterprises and other organizations is steadily growing and enterprises report that students are fast learners, are well grounded, and have strong awareness of the standards.

Teachers' teaching and engineering abilities have simultaneously enhanced. Through deep participation in enterprise practice, joint teaching, and collaborative project development, school teachers' engineering practice experience and industry insight have significantly increased. Relying on the course construction content, the school course director was approved for one Autonomous Region Undergraduate Education and Teaching Reform Research Project. The school and enterprise jointly and successfully applied for the Inner Mongolia Energy Group's open competition project "Research and Application of Ecological Photovoltaic Sand Control Technology in Desertification Areas," realizing a positive interaction between teaching reform and scientific research innovation.

The program has turned out to be a reliable and credible source and hub of product development

in partnership between school and enterprise. The company is now provided with a continuous flow of talented people and fresh concepts to explore in class. Co-construction of courses has also been encouraged and implemented in the main course and other courses in the field of engineering.

The current cooperation is also a set of issues that are required to be addressed, such as: involvement of the enterprise mentors into the teaching process during a long term, improved control of the diversity of assessments and evaluations, distribution and exchange of outcomes of the course reform. The course team plans in the future to increase the size of the core cooperatives enterprises to 3-5 upstream and downstream enterprises in the industry chain, which will constitute a "Course Co-construction Alliance", prepare a proposal on Measures to Appoint and Manage Enterprise Mentors and hold an "Enterprise Mentor Teaching Capacity Development Workshop", and create course construction guidelines and appraisal kits to create a replicative and marketable "Deep Industry-Education Integration Course Construction Plan".

6. Conclusion

School-enterprise co-construction is an effective path to solve the problem of disconnection between applied course teaching and industry needs. The course of the College of Desert Control Science and Engineering, Inner Mongolia Agricultural University, and the Power Survey and Design Institute Co. , Ltd. were the carrier in the development of a model of the co-construction of courses of two school-enterprise directors, complete penetration of the project and four-step scenario of the course construction. The process of teaching was also realized as an effective link between the teaching activity and production practice by the use of dynamic content updating, multi-scenario instruction, dual-mentor based project, and diversified school-enterprise evaluation which made students better in their engineering practice and professional qualities. The study gives a working paradigm of reference that can be used in building industry education integrated programs on soil and water conservation majors at other institutions of higher learning with the same purpose. In the future, the team of the course will focus on increasing the depth and the width of the cooperation, the upgrading of the course to the stage of school-enterprise win-win, the development of more high-quality applied professionals, and the creation of a solid ecological security line in the north part of China.

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