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Research on the Teaching and Education of Engineering Undergraduate Programs from the Perspective of the Connection between the Source Institutions and Majors of Students

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Abstract: Engineering-oriented associate-to-bachelor's education, as a key approach to building high-quality vocational education, is a crucial link in cultivating high-level technical and skilled talents. The quality of this education directly affects the effectiveness of cultivating applied bachelor's degree talents. However, currently, engineering-oriented associate-to-bachelor's students generally encounter academic adaptation difficulties during their cultivation due to factors such as the type differences of their original vocational colleges and the mismatch of professional alignment. This paper takes 246 students from different professional backgrounds and schools at Southwest Forestry University as the research subjects, deeply analyzes the characteristics and differences of engineering-oriented associate-to-bachelor's students from different backgrounds in terms of knowledge structure, practical ability, and learning paradigms, and systematically expounds the core challenges they face in professional theory deepening, curriculum system connection, and teaching mode adaptation after entering the undergraduate college. On this basis, this paper proposes a systematic educational and teaching reform direction from four dimensions: goal reconstruction, curriculum system reshaping, teaching mode innovation, and support system construction, aiming to achieve a transition from simple academic advancement to high-quality ability integration and improve the quality of engineering-oriented associate-to-bachelor's talent cultivation.

Keywords: Engineering Undergraduate Admission for Transfer from Vocational School, Student Source Differences, Professional Transition, Course System, Teaching Research.

1. Introduction

With the increasingly urgent demand for skilled technical and innovative talents with comprehensive abilities in China's industrial upgrading and transformation, the promotion and education from junior college to undergraduate level has become an important part of the modern vocational education system[1]. Due to its strong application and practical nature, the engineering field has become one of the largest and most in-demand areas in the undergraduate promotion education. A large number of vocational college graduates enter undergraduate institutions for further study through this path, hoping to enhance their theoretical knowledge and professional competitiveness[2-3].

However, unlike students who directly enter undergraduate programs through the regular college entrance examination, students in the undergraduate promotion program form a highly differentiated group. Their original promotion schools have significant differences in their school positioning, teaching staff, and practical training conditions. For example, there are national demonstration vocational colleges, ordinary vocational colleges, and application-oriented undergraduate colleges at the junior college stage, and although the names of the professional courses they learned during the junior college stage may be the same or similar to those of the undergraduate programs, the course settings, teaching depth, and training focus may be quite different. The diversity of the student source background and the incomplete professional connection lead to many students in the undergraduate promotion program experiencing difficulties in adapting and learning disconnection after entering the undergraduate program: struggling with theoretical course learning, having difficulty in transforming engineering thinking, and facing numerous difficulties in the research-based learning mode of the undergraduate program.

Therefore, the traditional, single-objective training plans and teaching models designed for undergraduate students alone have been unable to meet the actual needs of students in the engineering undergraduate promotion program[4-8]. This study aims to diagnose the key problems existing in engineering undergraduate promotion education from the two core variables of "original promotion school" and "professional connection", and construct a more targeted, connected, and effective educational and teaching system, which has important theoretical value and practical significance for ensuring and improving the quality of engineering undergraduate promotion talent cultivation.

2. Analysis of the Characteristics of Students Enrolled in Engineering Undergraduate Programs and the Challenges in Professional Alignment

2.1. The Diversity of the Source Institutions and its Impact

The students in this survey mainly come from three categories: 9 vocational colleges. They are divided into three levels based on their educational quality: The first tier consists of high-level demonstration vocational colleges. Among the 246 students participating in the survey, 172 are from three high-level institutions: Yunnan Transportation Vocational

College, Kunming Metallurgical College, and Yunnan Mechanical and Electrical Vocational College. These schools have advanced training facilities and focus on skill competitions. The students have strong practical abilities and rich experience in project-based learning. These schools have emphasized their skill advantages by strengthening the depth and breadth of theoretical courses.

The second tier consists of general vocational colleges: Among the 246 students participating in the survey, 71 are from five institutions: Yunnan Forestry Vocational College, Yunnan Agricultural Vocational College, Yunnan Energy Vocational College, Zhaotong Vocational College, and Honghe Vocational College. These schools have relatively ordinary educational conditions and focus more on the acquisition and operation of routine skills. Students' mastery of basic theories may not be solid, and their knowledge systems are relatively weak.

The third tier consists of specialized programs within application-oriented undergraduate colleges: Among the 246 students participating in the survey, 3 are from the junior college programs of Pu'er College and Wenshan College. These students have partially shared the teaching resources of undergraduate programs during their junior college years and are more familiar with the teaching models and management methods of undergraduate programs. The transition is relatively smooth, and in many cases, they receive undergraduate-level education for professional education.

The differences in this student source background lead to significant internal differences among students in the same undergraduate transfer class in terms of knowledge foundation, skill level, and learning habits, which poses a severe challenge to unified teaching at the undergraduate stage.

2.2. The Core Dilemma in Professional Integration

From colleges of the same professional field, there are gaps and overlaps in the knowledge system, which is the most prominent issue. The first and second-tier specialized curriculum systems usually follow the principle of "adequate and practical", emphasizing the mastery of technical points. However, in the undergraduate education stage, the main goal is to pursue the systematicness, completeness, and theoretical depth of the knowledge system. For example, students majoring in civil engineering, in their junior college years, mainly focus on teaching the operation of various measuring instruments and the use of engineering software, with little systematic theoretical principle learning. In the undergraduate education, it is required to deeply understand the principles of building structure, structural mechanics, and material theory, which creates a huge theoretical gap between junior college and undergraduate education. At the same time, some public basic courses or professional basic courses, such as computer basics and engineering drawing, are largely repeated learned in both stages, resulting in waste of teaching resources and students' time.

Displacement of ability structure: During junior college education, students mainly receive "skill-oriented" talent training, being good at following established procedures and solving routine operational problems. In undergraduate education, it aims to cultivate "technical" or "engineering" talents, emphasizing the cultivation of design ability, innovation ability, and the ability to analyze complex engineering problems. The leap from "skill operation" to "technical application and innovation" requires a fundamental transformation of the teaching model, and students are prone to experiencing inability and thinking adaptation during this process.

Separation of curriculum system and teaching methods: According to the survey, although our school does not directly apply the general undergraduate curriculum plans for the third and fourth years of ordinary undergraduates to the students for transfer to junior college, the study period is compressed to two years. This model ignores the particularity of the students' learning in the early stage of transfer to junior college and fails to design truly transitional courses that play a "bridge" role. In terms of teaching methods, it emphasizes theoretical teaching and discussions, which contrasts with the project-based teaching method commonly used in the junior college stage of "learning by doing and doing by learning", making it difficult for some students to adapt.

3. Establish a Comprehensive Engineering Undergraduate-To-Master Education System that Integrates "Connection, Integration and Improvement"

In response to the above situation, undergraduate institutions must take the initiative to reform and establish a personalized training system that is centered on students, focuses on connection, and aims at enhancing students' abilities.

3.1. Goal Reengineering: From "Academic Enhancement" to "Skill Enhancement"

Firstly, it is necessary to clearly define the training objectives of the engineering undergraduate promotion program. It should not merely be about enhancing academic qualifications; rather, it should be a strategic transformation from "skilled" vocational college graduates to "technical/engineering" undergraduate students. The training objectives focus on the following three dimensions: Knowledge dimension: Systematically review and consolidate the professional basic theories, bridge knowledge gaps, and construct a complete engineering knowledge system. Ability dimension: Strengthen the ability to apply theoretical knowledge to solve complex engineering problems, emphasize the cultivation of design, integration, and innovation capabilities, and achieve the transformation from "operator" to "engineer" in thinking. Quality dimension: Cultivate the spirit of craftsmanship, engineering ethics, teamwork, and lifelong learning abilities.

3.2. Course System Reengineering: Establishing a "Modular, Selectable" Flexible Curriculum Structure

Break the original rigid curriculum system and design a highly adaptable modularized course structure. For example: At the beginning of students' enrollment, through written tests, interviews, and skill assessments, their knowledge structure and ability levels can be precisely diagnosed. Based on the assessment results, a "pre-education bridging module" lasting several weeks can be set up, such as "Advanced Mathematics", "Engineering Mechanics", "Mechanics of Materials", "Surveying", etc., aiming to quickly fill the common and individual knowledge gaps and help students make a smooth transition.

Optimize "core" professional courses: Transform the core undergraduate courses into "customized" ones for upper-level education. Do not simply delete content, but restructure the teaching content, highlighting how theory guides practice and practice supports theory. For example: When teaching "Surveying", a large number of specific usage cases of instruments such as level meters, total stations, and GPS satellite systems that students were familiar with during their junior college stage can be combined to make the abstract theory concrete.

Offer differentiated and precise teaching: Based on the differences in student sources, different elective courses can be set up. For example: For students from high-level vocational colleges with strong practical abilities, courses such as "Innovation Project Practice" and "Advanced Manufacturing Technology Special Topics" can be emphasized, guiding them to develop towards the direction of technological innovation; for students with a strong theoretical foundation or those who are determined to pursue further studies, courses such as "Advanced Mathematics", "College English CET-4 and CET-6", and "MBA Entrance Examination Tutoring" can be offered.

Strengthen comprehensive practical internships: The undergraduate graduation design (thesis) is a key link in evaluating the quality of training. The topic sources should focus on engineering practice or school-enterprise cooperation projects. Encourage students to conduct research on topics such as process improvement, equipment modification, or technical application innovation based on their practical experience from the junior college stage, avoiding homogeneity with the topics of ordinary undergraduate students, and highlighting their comprehensive advantages.

3.3. Innovation in Teaching Models: Implementing Project-based and Online-offline Hybrid Teaching Methods

Make full use of the practical foundation that the students of the undergraduate-to-master program already have, and incorporate project-based learning throughout the entire training process. For example, in the civil engineering major, by designing a comprehensive beam-column structure, students can go from calculating the reinforcement to the final pouring and shaping of the beam-column, in the process of solving real engineering problems, they can independently connect and apply the theories they have learned, achieving the integration and internalization of knowledge, and completing the leap in ability.

Adopt a blended teaching model and utilize online teaching platforms. For example, in the surveying and mapping engineering and water supply and drainage engineering majors, some theoretical contents and prerequisite knowledge are made into online micro-lectures, which are provided for students to preview or review after class according to their own situations. The offline class time is mainly used for key and difficult point explanations, special topic discussions, project guidance, etc., to improve teaching efficiency.

Implement stratified teaching and group cooperation. In the forestry engineering major, in teaching, based on the results of the student admission assessment, conduct implicit or explicit stratified teaching, and assign tasks of different difficulties. At the same time, encourage students with different backgrounds to form study groups, engineering associations, etc., through mutual assistance and learning, to learn from each other's strengths and weaknesses, forming a good atmosphere where "theoretical advanced students" lead "practical advanced students" and make progress together.

4. Support System Construction: Improve the "Academic - Psychological - Career" Comprehensive Guidance Throughout the Process

The school is still continuously exploring the academic mentorship system. Based on the students' professional backgrounds and development intentions, teachers, graduate students, and counselors with corresponding backgrounds are assigned to serve as academic mentors for the students who are preparing for undergraduate-to-graduate studies. From the very beginning of their enrollment, personalized guidance on course selection, study planning, project practice, and career development suggestions are provided. This initiative has achieved excellent teaching results. The postgraduate enrollment rate of the students preparing for undergraduate-to-graduate studies has increased from 3% in 2022 to 13% in 2025, and the pass rate of CET-4 and CET-6 has also risen to 7%. They have achieved remarkable results in various professional competitions at all levels.

In terms of strengthening psychological counseling and fostering a sense of belonging, the college has established a secondary psychological counseling station. Based on the assessment results, it pays differentiated attention to the possible adaptation pressure and identity anxiety of the students preparing for undergraduate-to-graduate studies. Through theme class meetings, special lectures, individual counseling, and teacher-student symposiums, it enhances their sense of belonging and self-confidence to the new environment.

The school continuously strengthens in-depth cooperation with enterprises. In 2025, the college visited over 70 relevant enterprises and strengthened the practical internship bases for students preparing for undergraduate-to-graduate studies. By bringing the theoretical problems learned in their undergraduate studies back to the practical field, a spiral upward process of "theory - practice - re-theory" is achieved, and a smooth channel for their employment is opened.

5. Conclusion

Engineering undergraduate-to-master education is an important way to achieve diversified talent growth and meet the society's demand for high-level technical and skilled personnel. Facing the practical challenges brought about by the diversity of source institutions and the lack of smooth professional connections, undergraduate institutions must abandon the "one-size-fits-all" training model and establish an educational philosophy centered on students' development.

The future reform should focus on building a precise, flexible and integrated educational system. Through precise diagnosis, individualized teaching can be achieved; through modular courses, personalized training can be realized; and through project-based and blended teaching, the integration of knowledge and ability can be promoted. Only in this way can the connection problems of engineering undergraduate-to-master education be effectively solved, and students' potential can be truly stimulated, enabling their unique "combined undergraduate and master" experience to transform into core competitiveness, and cultivating outstanding engineering and technical talents who are both "hands-on" and "brainy", and are highly popular in society, providing solid talent support for the high-quality development of China's manufacturing industry.

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