Talent Cultivation Optimization of Sino-Russian 4+0 Cooperative Engineering Programs: From Resource Introduction to Competency Development — A Case of Mechatronic Engineering at Southwest Forestry University

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Abstract. Against the dual backdrop of China Russia strategic cooperation and emerging engineering education reform, the 4+0 Sino foreign cooperative education model serves as a vital pathway to cultivate interdisciplinary engineering talents with combined Russian language and mechanical electrical competencies. The 4+0 Mechatronic Engineering program jointly established by Southwest Forestry University and South Ural State University of Russia has long been confronted with four prominent challenges: disconnection between curriculum languages, imperfect bilingual practical training systems, homogenized talent cultivation, and deficient Sino Russian collaborative education mechanisms. Based on employment and further study statistics of graduates from the 2022 2025 cohorts under this program, talent cultivation schemes, and questionnaire interview data from teachers and students, this study adopts multiple research methods including data comparison, textual analysis and field interviews to systematically trace the root causes of cultivation dilemmas from operational, institutional and resource dimensions. A reform and optimization framework is constructed across four dimensions: curriculum integration, practical platform development, stratified talent cultivation, and Sino Russian collaborative quality control. Practical outcomes demonstrate that the implemented reforms have effectively enhanced students' competence in applying discipline specific Russian and interpreting bilingual engineering documents, as well as improved the overall quality of graduate employment and further education. The findings of this research can provide practical references for similar Sino Russian 4+0 engineering cooperative programs in forestry oriented universities.

Keywords: Sino-Russian cooperative education; bilingual engineering education; talent-cultivation dilemma; curriculum integration; **stratified training mechanism**

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1 Introduction

Against the backdrop of deepening industrial and forestry-equipment cooperation between China and Russia, market demand for bilingual mechanical engineering talents keeps growing. A large number of domestic universities have launched Sino-Russian 4+0 cooperative programs. Under this model, students complete all four-year study domestically, and qualified graduates can obtain dual academic degrees from both Chinese and Russian higher-education institutions. Such projects help introduce overseas high-quality engineering teaching resources without requiring large-scale student overseas exchange.

Southwest Forestry University launched the mechatronic engineering 4+0 cooperative program, introducing multiple core engineering courses from its Russian partner university. While the program brings international teaching resources, long-term teaching practice reveals prominent adaptation conflicts. The teaching framework inherited from Russian universities is originally designed for local student groups, and cannot fully match the learning foundation of Chinese undergraduates as well as domestic industry employment requirements[1].

Existing domestic research mostly focuses on macro-level policy interpretation of Sino-foreign cooperative education. Few studies carry out in-depth analysis oriented toward forestry-featured engineering majors. Most countermeasures proposed in previous literature remain superficial adjustments, lacking systematic thinking rooted in real-world teaching pain points. Based on graduate employment-further-study data, talent-cultivation documents and teacher-student interview records, this paper identifies four core training dilemmas, puts forward corresponding optimization pathways, and verifies reform effects through practical teaching observation. Table 1 presents the main differences before and after optimization.

2 Dilemma Analysis of Cooperative Training

2.1 Mismatch Between Language Courses and Professional Courses

The separation of language training and professional knowledge teaching constitutes the primary bottleneck of this program. Russian language courses are mainly arranged in the early academic stage and focus on

daily communication scenarios. Teaching content pays limited attention to mechanical drawings, process description and discipline-specific technical vocabulary[2].

When students enter senior-year Russian-taught professional courses, they encounter obvious barriers. Even students who pass general Russian examinations still struggle to read engineering drawings and understand technical lectures delivered in Russian. Such mismatch originates not only from course scheduling, but also from the isolation of two teaching teams. Russian-language teachers and Russian engineering instructors belong to independent management systems, without regular joint lesson-planning mechanisms. Consequently, language learning cannot effectively support professional study.

2.2 Deficiencies in Practical Training System

Practical teaching is the core link for engineering talent cultivation. The practical training modules introduced from Russia are developed for local industrial conditions and enterprise resources. When transplanted to Chinese campus environment, many preconditions behind the original practical design no longer hold[3].

On-campus practical training mostly adopts Chinese-language operation materials. Students finish hands-on exercises without exercising bilingual technical expression. Off-campus internship resources targeting Sino-Russian equipment industries remain insufficient. Opportunities for students to participate in real international engineering projects are very limited. Without authentic bilingual practical scenarios, students can hardly transform theoretical knowledge into bilingual engineering practice competence[3].

2.3 Homogenized Training Ignoring Student Differences

Students admitted to the cooperative program have large gaps in Russian foundation and learning objectives. Some students intend to pursue further study in Russia, some choose domestic employment, and others prepare for postgraduate entrance examinations. Nevertheless, the original training scheme adopts unified teaching requirements, failing to carry out differentiated guidance, which leads to poor learning effectiveness for part of students.

2.4 Imperfect Joint Teaching Management Mechanism

Many core courses are undertaken by visiting Russian teachers. Foreign teachers conduct short-term concentrated teaching, lacking long-term continuous tracking. There is no regular joint-teaching-research mechanism between Chinese and Russian teachers. Curriculum ideological-construction and textbook review work are not well implemented in imported courses.

3 Optimization Countermeasures for Talent Training

3.1 Coordinated Adjustment of Curriculum System

In course sequencing, Russian language courses are scheduled mainly before or during the advanced professional stage. Chinese foundational courses in mathematics, physics, engineering drawing and electrical technology precede most Russian professional courses in mechanics, manufacturing, control and mechatronic systems, while comprehensive practical training and graduation projects follow professional courses. This sequence forms a learning chain from knowledge preparation to system-level application[4].

3.2 Build a Multi-Level Practical Training Syste

Construct three-level practical links: on-campus experiment, discipline competition and off-campus enterprise practice. Integrate bilingual engineering-practice projects. Make full use of existing university experimental platforms, and expand cooperative enterprise internship resources, so as to improve students' hands-on engineering capability.

3.3 Implement Hierarchical Classified Training

Set up differentiated training directions for students: further-study track, domestic-employment track and postgraduate-examination track. After the initial language-foundation stage, students can select corresponding modules according to personal development goals. Dynamic adjustment is allowed for individual development paths.

3.4 Improve Sino-Russian Joint Teaching Quality Control

Establish regular communication channels between Chinese and Russian teachers. Standardize the management for short-term visiting teachers. Complete curriculum ideological-political adaptation and content review for imported courses. Strengthen the whole-process monitoring of course-teaching quality.

4 Implementation Effect and Existing Shortcomings

4.1 Practical Effect After Optimization

After implementing the above-mentioned reform measures, prominent improvements have been observed in multiple dimensions. The sequential conflict between language learning and professional courses has been relieved. Students' ability to understand Russian technical documents has been significantly enhanced.

The multi-level practical framework provides more bilingual practice opportunities. Hierarchical classified training effectively reduces failure rate among students with weak foundations and offers targeted curriculum support for different career orientations. The joint quality-control mechanism solves the discontinuity of after-class guidance. Table 1 intuitively reflects major changes of each training link before and after optimization[5-6].

4.2 Remaining Structural Defects

Despite visible progress, several structural constraints cannot be eliminated in a short period. The quantity of high-quality bilingual internship positions from cooperative enterprises is still limited[4].

Localized bilingual teaching materials tailored for forestry-mechatronic scenarios remain scarce. The development of special teaching cases requires long-term accumulation. In addition, the online resource platform is still at initial construction stage, and high-quality online bilingual practical cases for senior-grade courses are insufficient. These objective restrictions need continuous resource input in follow-up work.

5 Further Improvement Ideas

Facing the above-mentioned long-term bottlenecks, continuous iterative

optimization is required rather than one-time reform. Universities should keep expanding enterprise-university cooperation with Sino-Russian equipment-manufacturing enterprises, and develop more internship posts for bilingual engineering talents[4].
Joint compiling teams composed of Chinese professional teachers, Russian-language instructors and Russian experts can develop localized bilingual teaching resources. Moreover, the talent-cultivation system should keep dynamic updating. Taking graduate feedback and industry talent-demand survey as important basis, the university should review and adjust curriculum modules and practical projects every academic year.

6 Conclusions

Aiming at the 4+0 Sino-Russian mechanical cooperative program in forestry universities, this paper sorts out four major practical dilemmas including curriculum mismatch, insufficient practical links, homogenized training and imperfect joint management. Each dilemma is analyzed not only from surface phenomena but also from internal system and mechanism reasons.
Corresponding optimization schemes on curriculum reconstruction, multi-level practical platform construction, hierarchical classified training and joint teaching quality-control are proposed. Teaching practice proves that these measures effectively relieve the adaptation contradiction caused by directly importing foreign curriculum systems. At the same time, this research also objectively points out existing objective resource-based constraints. The research results can offer practical reference for similar Sino-Russian cooperative-education projects in forestry-featured institutions.

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