

Research on the Optimization of Teaching Content and Curriculum Design of Scientific and Technological Foreign Languages Oriented to Technological Innovation

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ABSTRACT Technological innovation promotes the upgrading of the industry and increases the demand for foreign language professionals with scientific literacy, technical communication ability, and interdisciplinary innovation competence. Traditional teaching models can no longer fully meet the needs of professional integration and innovative talent cultivation. This study proposes a technology-innovation-oriented optimization framework for scientific and technological foreign language teaching. The teaching content system integrates professional knowledge, language skills, and innovative thinking, and establishes a hierarchical framework combining technical cognition, language expression, and innovation application. Curriculum design follows three principles: interdisciplinary collaboration, problem-driven learning, and intelligent technology assistance. A modular and progressive teaching system is then constructed to support personalized learning and professional communication training. Teaching experiments with a multidimensional evaluation mechanism verify the effectiveness of the reform in improving students' language application ability and innovation practice ability in real engineering scenarios. The study provides support for cultivating internationalized interdisciplinary professionals and offers references for technical communication in advanced engineering fields, including electromagnetic waves, antennas, and propagation-related research contexts.

INDEX TERMS technological innovation, scientific foreign languages, curriculum design, technical communication, electromagnetic engineering

I. INTRODUCTION

THE intensification of global scientific competition and the deepening of industrial transformation have positioned advanced textile technological innovation as a core driving force for national development and high-end manufacturing. As an important link in cultivating international innovative talents, scientific and technological foreign language education urgently needs reform. Current scientific and technological foreign language teaching generally has problems such as outdated content compared with technological development, disconnection from professional knowledge, and insufficient cultivation of innovative capabilities [1], which are difficult to meet the needs of emerging technical fields for compound talents [2]. Teaching reform oriented to technological innovation requires re-examining the positioning of foreign language teaching, transforming it from pure language tool training to the collaborative cultivation of language competence, professional literacy and innovative thinking. This requires systematically optimizing

teaching content, constructing a scientific curriculum design framework, and establishing a teaching ecology oriented to technological innovation. Through theoretical exploration and practical innovation, this research provides a theoretical basis and implementation plans for transforming scientific and technological foreign language teaching to meet the evolving high-tech demands of the industry.

II. CONSTRUCTION OF THEORETICAL FRAMEWORK FOR SCIENTIFIC AND TECHNOLOGICAL FOREIGN LANGUAGE TEACHING DRIVEN BY TECHNOLOGICAL INNOVATION

A. THREE-DIMENSIONAL TEACHING MODEL OF "TECHNICAL COGNITION-LANGUAGE EXPRESSION-INNOVATION APPLICATION"

Scientific and technological foreign language teaching needs to break through the limitations of traditional single language skill training and construct a three-dimensional teaching model integrating technical cognition, language expres-

sion and innovation application. The technical cognition level requires students to master the core concepts, technical principles and development trends of professional fields, and this cognitive ability lays a knowledge foundation for accurate language expression. The language expression level emphasizes the precise application of professional terms, standardized writing of academic genres, and cultivation of cross-cultural technical communication capabilities, enabling students to transform technical cognition into effective language output [3]. The innovation application level integrates technical cognition and language expression into real technical scenarios. "Innovation" here is measured by three specific indicators: the rationality of technical scheme improvement suggestions, the originality of cross-cultural technical communication methods, and the flexibility of professional language application. Students realize capability transfer through practical activities such as optimizing existing technical documents, designing international project collaboration schemes and presenting innovative technical ideas, and their innovative performance is evaluated through multi-dimensional rubrics. The three dimensions present a spiral upward interactive relationship: the depth of technical cognition directly affects the professionalism of language expression; language expression ability promotes the improvement of technical communication efficiency; innovative application practice in turn promotes the expansion of technical cognition and the refinement of language ability, thus forming a virtuous cycle of competence cultivation mechanism [4], as shown in Figure 1.

B. MAPPING MECHANISM BETWEEN TECHNOLOGICAL INNOVATION ELEMENTS AND FOREIGN LANGUAGE CAPABILITIES

The technological innovation process consists of four core elements: problem identification, knowledge integration, scheme design and achievement transformation. Each element corresponds to specific foreign language ability requirements, forming a clear mapping relationship. In the problem identification stage, students need the ability to read cutting-edge literature and understand technical challenges. To achieve this, they should master about 3,000-5,000 professional terms and accurately grasp the core arguments of the literature [5]. The knowledge integration stage involves critical analysis and synthesis of multi-source information. The corresponding foreign language abilities include logical analysis, information screening and viewpoint comparison in academic reading. Students need to process about 3,000-4,000 words of 2-3 related documents within 30 minutes and extract key information, which is more in line with the actual reading and analysis ability of foreign language learners. The scheme design stage requires clearly expounding technical routes and innovation points in foreign languages, which relies on academic writing ability, especially the standardized expression of technical description and argumentation. Technical reports need to reach a depth of 2,000-3,000 words. The achievement transformation stage requires

international communication, patent application or paper publication through foreign languages [6], corresponding to oral presentation ability, professional genre writing ability and cross-cultural communication skills, so that foreign language teaching and technological innovation practice form an organic unity.

Mapping model of technological innovation elements and foreign language capabilities:

$$C = f(T, L, I) \quad (1)$$

Where C is the comprehensive innovation capability index, T is the technical cognition level (0-1 standardized), L is the language expression ability (0-1 standardized), I is the innovation practice index (0-1 standardized), f is the nonlinear mapping function, and $f(T, L, I) = 0.35T + 0.30L + 0.35I + 0.15(T \times L \times I)$.

This model reflects the independent contributions of technical cognition, language expression and innovation practice as well as the synergistic effect of the three. The interaction term coefficient of 0.15 indicates the additional contribution of the synergistic effect of the three elements to innovation capability.

C. THEORETICAL BASIS AND IMPLEMENTATION PATH OF INTERDISCIPLINARY KNOWLEDGE INTEGRATION

Interdisciplinary knowledge integration is based on Cognitive Load Theory and Constructivist Learning Theory [7], emphasizing the organic integration of engineering technology, information science, management and other interdisciplinary content into foreign language teaching to cultivate students' compound thinking ability. Cognitive Load Theory guides teaching design to reasonably distribute the proportion of intrinsic cognitive load, extraneous cognitive load and germane cognitive load, reduce students' cognitive pressure through modular content presentation, and promote deep learning through problem-oriented task design. Constructivist Theory emphasizes that students actively construct knowledge systems in real situations [8], so teaching needs to create interdisciplinary collaborative projects to enable students to naturally integrate language learning and professional knowledge in the process of solving practical technical problems. Implementation paths include building an interdisciplinary teaching team for collaborative teaching, developing foreign language textbooks integrating professional content, designing technology-oriented comprehensive project tasks, and establishing learning communities with multi-disciplinary backgrounds. This integration is not a simple accumulation of knowledge, but embedding language as a tool into the process of professional problem-solving through real technical scenarios, enabling students to naturally improve their foreign language application ability while completing technical tasks, and ultimately forming a knowledge structure where language ability and professional literacy support each other.

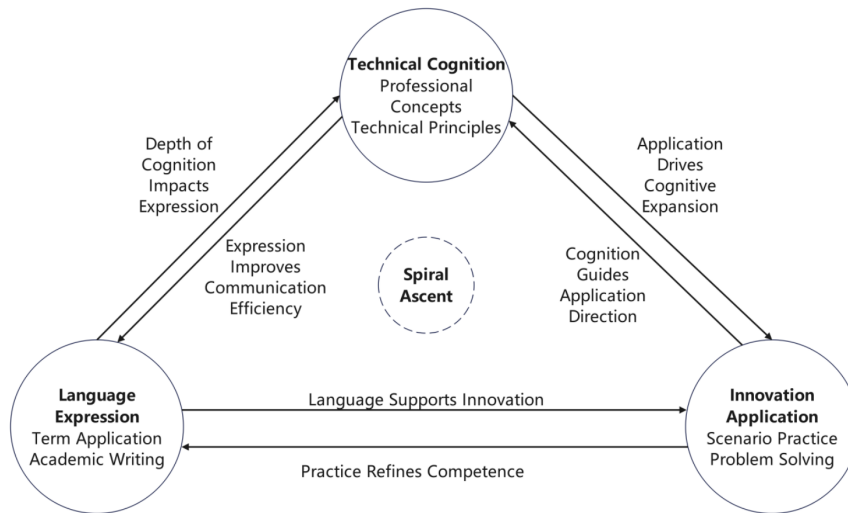


FIGURE 1. Interactive Relationship Diagram of the "Technical Cognition-Language Expression-Innovation Application" Three-Dimensional Teaching Model

III. SYSTEMATIC OPTIMIZATION OF TEACHING CONTENT ORIENTED TO TECHNOLOGICAL FRONTIERS

A. CONSTRUCTION METHOD OF DYNAMICALLY UPDATED PROFESSIONAL DOMAIN CORPUS

The construction of a professional domain corpus needs to establish a dynamic update mechanism to ensure that teaching content keeps pace with technological development. Corpus sources include technical papers published in top international academic journals in the past three years, technical white papers released by mainstream technology enterprises, technical specification documents updated by international standardization organizations, and technical speech texts of industry leaders. These sources ensure the cutting-edge and authority of the corpus. Corpus selection follows a professional relevance scoring mechanism, using the TF-IDF algorithm to calculate the correlation between texts and the target professional field. Only texts with a correlation threshold above 0.75 can be included in the corpus, and manual review by professional teachers is combined to ensure quality. The corpus is classified with three-dimensional annotations according to technical themes, difficulty levels and genre types. Technical themes cover 12 cutting-edge fields such as artificial intelligence, Internet of Things and new energy. Difficulty levels are divided into basic, advanced and high-level according to vocabulary density and syntactic complexity. Genre types include six categories such as academic papers, technical reports and patent specifications. The update cycle is optimized to supplement 8-10% of new corpus every semester, focusing on adding cutting-edge technical content in rapidly developing sub-fields of Foundational literature with enduring academic materials value is retained, and only obsolete technical descriptions or outdated terminology-related content are eliminated. This balance between timeliness and foundation ensures the corpus remains aligned with technological progress while avoiding premature discarding of core professional knowledge [9]. By regularly analyzing

the change trend of high-frequency terms to judge the direction of technological development, the corpus always reflects the state of technological frontiers and provides fresh materials for teaching, as shown in Table 1.

TABLE 1. Construction Dimensions and Standards of Professional Domain Corpus

Dimension	Classification Standards	Specific Content	Update Frequency
Technical Theme	Cutting-edge field division	12 categories including artificial intelligence, Internet of Things, new energy, etc.	Annual adjustment
Difficulty Level	Vocabulary density/syntactic complexity	Basic (<0.5), Advanced (0.5-0.7), High-level (>0.7)	Fixed standards
Genre Type	Text functional characteristics	Papers, reports, patents, standards, speeches, comments	Fixed classification
Timeliness	Release time	Technical literature published in the past three years	15-20% per semester

B. CULTIVATION OF CRITICAL READING AND ACADEMIC WRITING ABILITIES FOR TECHNICAL LITERATURE

The cultivation of critical reading ability for technical literature needs to establish a hierarchical and progressive training system, which gradually deepens from text comprehension and logical analysis to critical evaluation. The text comprehension level requires students to accurately grasp the research questions, technical routes and core conclusions of the literature. Training methods include tasks such as abstract reconstruction and key information extraction. Students need to complete the structured combing of 5,000-word literature within 20 minutes. The logical analysis level strengthens students' ability to examine the argumentation process. Through training such as identifying argument types, evaluating evidence sufficiency and testing reasoning validity, students master the basic norms of academic ar-

gumentation. Specific tasks include drawing argumentation structure diagrams and comparing methodological differences between different studies. The critical evaluation level cultivates students' questioning spirit and innovative awareness, requiring them to judge the limitations of research, identify potential biases and propose improvement directions. The cultivation of academic writing ability promotes each other with critical reading. Writing training adopts a three-step progressive model of imitation-writing, revision-writing and creative-writing. On the basis of imitating the writing paradigm of excellent literature, students gradually form their own academic expression style. The curriculum sets modular tasks such as technical review writing, research proposal writing and academic paper writing. Each task is supported by detailed evaluation rubrics to clarify multi-dimensional standards such as language accuracy, logical rigor and innovation [10], enabling students to internalize academic writing norms and improve technical thinking ability through repeated practice.

C. DEVELOPMENT OF MULTI-MODAL TEACHING RESOURCES ON TECHNOLOGICAL INNOVATION THEMES

Multi-modal teaching resources integrate various media forms such as text, images, videos and interactive simulations to adapt to different learning styles and enhance teaching effects. Text resources include reading materials adapted from real technical literature, writing examples compiled according to industry standards, and oral scripts simulating international conferences. These materials have undergone difficulty adjustment and language polishing to be more suitable for teaching use. Image resources cover technical principle diagrams, process flow charts, data visualization charts, etc. Visual presentation helps students understand technical concepts and master the foreign language expression of professional charts. Video resources select real-scene recordings such as keynote speeches at international technical forums, enterprise product launches and academic conference reports, with key term annotations and cultural background explanations, allowing students to immerse themselves in real technical communication contexts to improve listening and speaking abilities. Interactive simulation resources create technical work scenarios close to reality through tools such as virtual laboratories, online collaboration platforms and technical question-and-answer systems. Students comprehensively apply foreign language knowledge and professional skills in the process of completing virtual projects [11]. Resource development follows the principle of cognitive load optimization, decomposing complex technical content into several micro-learning units. Each unit is controlled within 15-20 minutes and accompanied by self-test exercises. At the same time, a resource usage data tracking mechanism is established to continuously optimize resource design according to students' learning behavior data, thus building a digital teaching resource ecology with strong adaptability, as shown in Table 2.

TABLE 2. Types and Functional Orientation of Multi-Modal Teaching Resources

Resource Type	Main Forms	Teaching Functions	Application Scenarios
Text Resources	Adapted literature, writing examples, oral scripts	Cultivate reading and writing abilities	In-class intensive reading, writing training
Image Resources	Schematic diagrams, flow charts, data charts	Visualize technical concepts	Concept understanding, chart expression
Video Resources	Speeches, press conferences, conference reports	Improve listening and speaking abilities	Listening training, scenario simulation
Interactive Resources	Virtual experiments, collaboration platforms, question-and-answer systems	Comprehensive skill application	Project practice, collaborative learning

IV. CURRICULUM DESIGN AND ORGANIZATION IMPLEMENTATION SUPPORTED BY INTELLIGENT TECHNOLOGY

A. DESIGN OF MODULAR CURRICULUM FRAMEWORK ORIENTED TO ABILITY PROGRESSION

The modular curriculum framework constructs a three-level progressive system of "Language Foundation- Professional Application-Comprehensive Innovation" according to the law of students' ability development. This system is suitable for junior-year professional elective courses and sets a total teaching cycle of 56 class hours. The language foundation module accounts for 16 class hours, focusing on the establishment of scientific and technological vocabulary systems and academic text reading strategies. It requires students to master about 1,500 high-frequency professional terms and accurately identify the textual structure of technical literature. Through intensive reading of 5-8 typical technical literature, this module enables students to establish basic academic reading abilities. The professional application module accounts for 24 class hours and is set as the core link of the curriculum. It cultivates students' professional expression abilities through critical reading training, academic writing practice and oral presentation drills. Under the guidance of teachers, students need to complete the writing of 1,200-1,500-word technical reviews and 10-minute technical presentations. The comprehensive innovation module accounts for 16 class hours and adopts project-based learning. Students complete 1-2 technical theme research and scheme design tasks in groups. This module emphasizes the comprehensive application of language abilities in real technical scenarios [12]. The three modules achieve smooth transition through ability connection points, and the output results of the previous module constitute the learning foundation of the subsequent module, thus forming a spiral upward ability cultivation path, as shown in Table 3.

TABLE 3. Modular Curriculum Framework and Teaching Implementation Plan

Curriculum Module	Class Hours	Core Content	Ability Objectives	Outcome Forms	Assessment Methods
Language Foundation Module	16	Scientific and technological vocabulary, textual structure, reading strategies	Master 1,500 terms, understand literature frameworks	Literature analysis	Vocabulary tests, structure combing reports
Professional Application Module	24	Critical reading, review writing, oral presentation	Write 1,200-word reviews, complete 10-minute presentations	Technical reviews, PPT presentations	Writing evaluation, presentation scoring
Comprehensive Innovation Module	16	Project research, scheme design, team collaboration	Complete small technical theme projects	Project proposals	Project defense, process evaluation

B. PROBLEM-DRIVEN COLLABORATIVE LEARNING ORGANIZATION MODEL

Problem-driven collaborative learning carries out teaching activities around 3-4 progressive technical problems. Each problem lasts for 3-4 weeks and corresponds to a main learning stage of the curriculum. The selection of technical problems follows the three principles of "authenticity-appropriateness-openness". Problems are derived from practical application scenarios in cutting-edge fields such as intelligent manufacturing, new energy and biotechnology. After adaptation by teachers, the difficulty is adapted to students' current ability level with a certain exploration space [13]. Learning groups consist of 4-5 students with a role division mechanism. Members serve as project coordinators, literature researchers, technical analysts and document writers respectively. Roles are rotated among different problems to achieve comprehensive ability training. The problem-solving process adopts a four-stage promotion framework of "task analysis-information retrieval-scheme demonstration-achievement presentation". Teachers provide targeted language support and professional guidance at each stage, and monitor group progress through regular checkpoints to adjust teaching strategies in a timely manner. Collaborative achievements are presented in multiple forms such as technical reports, scheme presentations and group defenses. The evaluation system comprehensively considers three dimensions: individual contribution (40%), group achievement quality (40%) and process performance (20%), making the evaluation focus not only on the final output but also on the efforts and growth in the learning process.

C. CONSTRUCTION OF PERSONALIZED TEACHING ENVIRONMENT EMPOWERED BY ARTIFICIAL INTELLIGENCE

The construction of a personalized learning environment adopts a hybrid model of "existing platform + manual intervention". When technical conditions permit, intelligent tools are introduced to assist teaching with teachers as the core guarantee. The curriculum uses mature writing assistance platforms such as Pigaiwang and iWrite for preliminary diagnosis of technical documents submitted by students. These tools mainly identify basic problems such as vocabulary use, grammatical errors and syntactic norms and generate feedback reports. For high-level issues such as

content logic, argument rigor and professional accuracy specific to engineering, teachers provide targeted in-depth revision and guidance combined with professional background knowledge, making up for the limitations of general-purpose writing tools in specialized fields. Learning management systems (such as Moodle and Rain Classroom) track students' online learning behavior data, including resource access frequency, test completion status and discussion participation. Teachers understand the overall learning status of the class and identify individual students in need of additional support through data dashboards [14]. The resource push mechanism provides hierarchical learning materials according to students' learning progress and test performance. Students with weak foundations receive vocabulary intensive exercises and simplified reading materials, while students with strong abilities are exposed to more difficult literature and extended tasks [15]. For teaching environments lacking intelligent platform support, teachers can adopt traditional strategies such as heterogeneous grouping, peer assistance and stepped tasks to achieve differentiated teaching. They make up for the lack of technical means by increasing individual counseling time and establishing learning mutual assistance groups, ensuring that the concept of personalized teaching can be effectively implemented under different conditions, as shown in Table 4.

TABLE 4. Personalized Learning Support Strategies and Implementation Paths

Support Type	When Technical Conditions Are Sufficient	When Technical Conditions Are Limited	Target Groups	Implementation Frequency
Writing Feedback	Pigaiwang + teacher in-depth revision	Teacher detailed revision + peer review	All students	Each assignment
Learning Diagnosis	Learning management system data analysis	Regular tests + classroom observation	All students	Every 2 weeks
Resource Push	System automatic recommendation + teacher supplement	Teacher hierarchical assignment + resource library self-selection	Students of different abilities	Every week
Individual Counseling	Online Q&A + offline interviews	Increased counseling time + mutual assistance groups	Weak students	On-demand arrangement

V. TEACHING REFORM EFFECT VERIFICATION AND MULTI-DIMENSIONAL EVALUATION SYSTEM

A. TEACHING EXPERIMENT DESIGN AND CONTROL GROUP EFFECT ANALYSIS

The teaching experiment adopts a quasi-experimental design method, selecting two natural classes of junior-year students majoring in the same subject in a university as research objects. The experimental group (32 students) receives curriculum reform teaching oriented to technological innovation, while the control group (30 students) receives traditional teaching mode. The experimental cycle is a complete semester with a total of 16 weeks. Baseline tests are conducted for students in both groups before the experiment. The test tools include standardized professional foreign language proficiency tests and self-compiled technical literature reading comprehension tests. The results show that there is no significant difference between the two groups in language ability (mean score: experimental group 61.2 ± 5.8 , control group 60.8 ± 6.1 ; $p = 0.78$) and professional knowledge level (mean score: experimental group 59.5 ± 4.9 , control group 58.9 ± 5.3 ; $p = 0.63$), providing a reliable comparison basis for subsequent effect analysis. This study was approved by the Ethics Committee of Harbin University of Science and Technology, and was performed in accordance with the principles of the Declaration of Helsinki. All eligible participants signed an informed consent form. During the experiment, strict variable control measures are implemented: both groups use the same basic textbook to ensure consistent core knowledge input. The experimental group supplements the dynamically updated professional domain corpus as extended learning materials, while the control group uses traditional static extended readings with the same difficulty level and theme scope. Teachers and teaching objectives are unified, and the

only variable is the teaching content update mechanism and organization method, ensuring the validity of experimental results [16]. The only difference lies in the teaching methods and content organization. At the end of the semester, data are collected through multi-dimensional evaluation tools, covering dimensions such as professional vocabulary mastery, technical literature reading speed and comprehension depth, academic writing quality and oral presentation ability. Data analysis uses paired sample t-tests and covariance analysis to compare the progress of students in the two groups. The results show that the critical reading ability of technical literature in the experimental group is improved by 42%, significantly higher than 18% in the control group. The academic writing quality score is increased by 35% while that in the control group is only increased by 12%. These data indicate that the reform plan has significant advantages in cultivating students' comprehensive application ability of professional foreign languages, as shown in Table 5.

TABLE 5. Comparative Analysis of Teaching Effects Between Experimental Group and Control Group

Evaluation Dimension	Experimental Group (n = 32)	Control Group (n = 30)	Improvement Difference	Statistical Significance
Professional Vocabulary Mastery (pieces)	1680→2420	1650→2050	+740 vs +400	$P < 0.01$
Literature Reading Speed (words/minute)	85→128	88→105	+43 vs +17	$P < 0.05$
Critical Reading Ability (100-point scale)	62→88	64→75	+42% vs +18%	$P < 0.01$
Academic Writing Quality (100-point scale)	58→78	60→67	+35% vs +12%	$P < 0.01$
Oral Presentation Ability (100-point scale)	55→76	57→65	+38% vs +14%	$P < 0.05$

B. MULTI-DIMENSIONAL EVALUATION INDEX SYSTEM BASED ON TECHNOLOGICAL INNOVATION CAPABILITY

The multi-dimensional evaluation index system constructs a comprehensive evaluation framework from three dimensions: language ability, technical cognition and innovative literacy. Each dimension includes several observable secondary indicators with clear scoring standards. The language ability dimension sets three indicators: accuracy of professional term application, standardization of academic genres and appropriateness of cross-cultural communication. The evaluation methods include standardized tests (30%), writing work analysis (40%) and oral presentation scoring (30%), accounting for 35% of the total evaluation weight. The technical cognition dimension includes three indicators: depth of cutting-edge technology understanding, literature information integration ability and logic of problem analysis, which are assessed through technical review quality, literature review reports and scheme design documents, with a weight of 30%. The innovative literacy dimension focuses on students' critical thinking, scheme innovation and team

collaboration ability, evaluated by a combination of project defense (50%), peer evaluation (25%) and self-reflection reports (25%), with a weight of 35%. The evaluation system introduces a process-oriented evaluation mechanism, making the proportion of phased learning achievements reach 60% while the final assessment only accounts for 40%. This design encourages students to continuously invest in the learning process rather than cramming for exams temporarily. At the same time, an evaluation data file is established to track the trajectory of students' ability development to support personalized guidance decisions.

C. DATA-DRIVEN MECHANISM FOR CONTINUOUS IMPROVEMENT OF TEACHING QUALITY

The data-driven quality improvement mechanism establishes a four-link closed-loop system of "data collection-analysis and diagnosis-strategy adjustment-effect verification", which realizes the dynamic optimization of teaching plans through continuous monitoring of teaching process data. The data collection link obtains information from multiple channels such as learning management platforms, classroom observation records, student assignment files and questionnaires. The collected content includes indicators such as students' attendance rate, assignment completion quality, discussion participation and learning satisfaction. The data collection frequency is set to conduct systematic summary every two weeks. The analysis and diagnosis link uses descriptive statistics and correlation analysis to identify weak links in the teaching process. When a certain indicator is lower than the preset threshold (such as assignment excellence rate below 60% or satisfaction below 3.5 points), the system automatically triggers an early warning mechanism to remind teachers to pay attention. The strategy adjustment link revises teaching content difficulty, adjusts teaching rhythm or improves teaching methods according to diagnosis results. The adjustment plan is determined through discussions by the teaching team and implemented in subsequent teaching with adjustment effects recorded. The effect verification link evaluates the effectiveness of improvement measures by comparing changes in key indicators before and after adjustment, with a verification cycle of 4 weeks. If the improvement effect is not significant, it enters a new round of problem diagnosis and scheme optimization, thus forming a spiral upward quality improvement path, as shown in Figure 2.

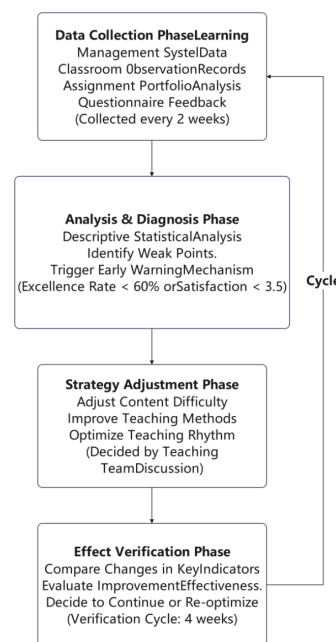


FIGURE 2. Data-Driven Closed-Loop Mechanism for Continuous Improvement of Teaching Quality

VI. CONCLUSION

The reform of scientific and technological foreign language teaching oriented to technological innovation must form a complete closed loop encompassing theoretical construction, content domain-specific reconstruction, design innovation, and effect verification. The proposal of the three-dimensional teaching framework provides theoretical support for teaching reform. Systematic content optimization ensures the synchronization of teaching with technological frontiers. The in-depth application of intelligent technology enhances the pertinence and effectiveness of teaching. Empirical research verifies the feasibility of the reform plan. This systematic innovation breaks through the limitations of traditional foreign language teaching and realizes the organic unity of language training and innovative ability cultivation. Practice shows that students' abilities in professional foreign language application, technical literature understanding and cross-cultural collaboration have been significantly improved. Future research can further explore interdisciplinary collaborative teaching mechanisms and deepen the industry-university-research talent training model to promote high-quality scientific foreign language education and cultivate innovative professionals with the international competitiveness required to build an innovative country.

AUTHOR CONTRIBUTIONS

Tiantian Shi designed, collected and analyzed the data, and drafted the manuscript. Tiantian Shi conducted the study, critically revised the manuscript for important intellectual content, and gave final approval of the version to be published. Tiantian Shi participated fully in the work, take public responsibility for appropriate portions of the content,

and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Ethics Committee of Harbin University of Science and Technology, and was performed in accordance with the principles of the Declaration of Helsinki. All eligible participants signed an informed consent form.

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