ISSN 2522-6398 Vol. 8, Issue 9: 61-66, DOI: 10.25236/FER.2025.080911

AI-Driven Professional English for Electrical Engineering Teaching Design: Closed-Loop Training from Professional Literature Reading to International Academic Communication

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Abstract: *The deepening of international collaboration in the field of electrical engineering puts forward higher requirements for the professional English ability. Traditional teaching suffers from weak academic writing, ineffective intensive reading of literature, and lack of international communication. This study builds an AI-assisted closed-loop training model that includes searching, reading, writing and expression. Through the design of classroom instructional content and team-based practical tasks, deep integration between professional English proficiency and engineering practice is achieved. This model significantly enhances students' technical documentation productivity and academic discourse competence, thereby providing a replicable, data-informed pedagogical pathway for the internationalization of engineering education.*

Keywords: *Professional English for Electrical Engineering, Close Loop Teaching Design, AI-Driven*

1. Introduction

1.1 The Purpose and Status of Teaching English Courses for Electrical Engineering Majors

As the global energy transition accelerates, the depth and breadth of international collaboration in the field of electrical engineering continues to expand. Practitioners participating in international standard setting and leading multinational engineering projects need to accurately use professional English to process technical documents, write academic papers, and conduct engineering negotiations. In this context, the core purpose of teaching English in electrical engineering is explicitly to develop students' professional language skills. Undergraduate students are required to have the ability to apply terminology accurately and understand the engineering semantics of cutting-edge terminology. They are required to have the ability to produce technical texts and independently write IEEE-compliant academic papers, English-language technical reports and equipment manuals. And they are required to have the ability to communicate internationally and efficiently communicate their engineering viewpoints in conference defense and technical negotiation scenarios.

However, there is a significant disconnect between current undergraduate teaching practices and these goals. At the level of teaching content, the updating of teaching materials is seriously lagging. Most textbooks are still centered on traditional electrical machinery and relay protection, with insufficient coverage of terminology in emerging areas such as smart grids and new energy grid integration. Key technical concepts such as "virtual synchronous generator" and "grid-forming converter" are generally missing. This leads to a terminological disconnect when students are exposed to real engineering materials. As for teaching method, excessive emphasis is placed on terminology recitation and sentence translation, while academic writing standard training and international communication scene simulation are neglected. In terms of feedback on teaching outcomes, it is difficult for instructors to provide personalized critique of technical document writing in large-scale lecture scenarios, and the effectiveness of instruction is low. Students' academic writing errors are perpetuated, which has a serious impact on the publication of high-level results in their future academic studies.

Collectively, these issues converge on a fundamental dilemma: traditional pedagogical models fail to

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effectively support the goal of learning what is needed and applying what is learned, thereby proving inadequate in meeting the advanced demands for integrated professional English competencies within globalized engineering practice. This deep-seated malpractice of divorcing learning from application perpetuates a recurrent predicament wherein graduates exhibit proficiency in technical text comprehension yet deficiency in oral communication, competence in translation but incapacity in composition when engaging transnational projects. Consequently, restructuring a practice-oriented professional English instructional framework constitutes an imperative under the Emerging Engineering Education reform and talent cultivation paradigm.

1.2 Integration Approaches and Implementation Scenarios of AI technologies

Artificial intelligence technology, represented by large-scale language modelling (LLM), opens up innovative paths to solve the above teaching challenges. LLMs demonstrate transformative potential in intelligently parsing and structurally extracting information from massive volumes of technical literature, as well as interactively generating and refining high-quality academic texts, as exemplified by tools like ChatPDF and ChatDoc. Rather than simply replacing the role of educators, these capabilities provide a robust technological foundation for restructuring pedagogical ecosystems within professional English education.

LLMs can be leveraged to efficiently construct dynamic knowledge graphs and intelligent literature library within the electrical engineering field. AI tools can retrieve and filter the latest technical standards, top journal papers, and industry white papers in real time by connecting to academic databases such as IEEE Xplore and ScienceDirect[1]. When reading literatures, AI tools can assist students in identifying and extracting keywords, technical schematics, and methodological frameworks, as well as generating summaries. AI-powered study tools can transform static paper reading into active interactive learning by enabling students to consult challenging sentences. These systems provide real-time explanation of complex syntax, specialized abbreviations, and technical backgrounds, ensuring instructional content remains synchronized with disciplinary frontiers. Leveraging the content generation and adaptability of LLMs, integrated with analysis of student learning behaviors and competency profiles, the system enables personalized adaptive learning. AI dynamically generates matching reading materials, technical case studies, translation exercises and extension questions based on the direction of the student's interests.

AI-assisted tools can not only explain the meaning of words and phrases, but also correlate the electrical engineering knowledge system and analyze the engineering principles behind technical concepts[2]. In addition, an AI-enabled formative evaluation system can be constructed to integrate students' data in the whole process of literature parsing, writing output, oral interaction, and translation practice. By tracking and analyzing student performance across various tasks, the visual ability radar charts and personalized diagnostic reports are generated. These reports cover four key dimensions: terminology accuracy, depth of technical concept understanding, complexity of expression, and communication efficiency.[3]. In summary, this study will explore the AI-enabled professional English for electrical engineering teaching design. It focuses on multi-dimensional introductions and immersive application scenarios to construct a closed-loop teaching system that integrates learning with practice.

2. Instructional Content Design: AI-Assisted Multi-dimensional Competency Training

With the core objective of cultivating globalized engineers, the professional English for electrical engineering course builds a closed loop of competence in technical literature retrieval, professional text reading, academic engineering writing and international technical expression. The course firstly focuses on intelligent literature searching ability, guiding students to use professional databases, e.g. IEEE Xplore, IET, etc., to accurately obtain cutting-edge technical literature, international standards and patents. For example, to carry out multi-dimensional literature mining for the topic of "DC network fault protection". On this basis, deepen the critical reading literacy of engineering texts. By deconstructing the technical standards, research papers and engineering reports, students are trained to quickly locate key parameters, analyze technical logic and assess academic value. The bilingual technical writing skills are standardized in teaching by incorporating genres such as IEEE format academic papers, lab reports, and equipment manuals. The training will focus on addressing key challenges in engineering writing, including terminology consistency, passive voice transitions, and data visualization. The ultimate goal of the course is to cultivate students' comprehensive expression skills in project presentation and cross-cultural collaboration in engineering English through real-life scenario-based exercises.

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2.1 Intelligent Academic Literature Search

In the professional English for electrical engineering course, the intelligent academic literature search needs to break through the limitations of traditional keyword search. A training program is developed that is guided by critical thinking, driven by real-world engineering problems, and supported by an AI tool.

(1) Efficient search and semantic matching

Traditional retrieval methods typically involve inputting single keywords into search systems, making it challenging for students that not familiar with academic literature to swiftly identify highly relevant publications from vast foreign-language databases. In contrast, AI-powered semantic expansion tools generate compound queries that precisely target high-relevance literature published within the last three years, which avoids static keyword usage, information overload, and inefficient screening. These tools also interpret natural language inputs or imprecise terminology to match conceptually related keywords, thereby expanding search coverage while mitigating the risk of overlooking critical literature.

(2) Knowledge graph construction

In teaching, students are guided to use AI tools to extract technical solutions, parameters and challenges from the literature, and build professional maps in the knowledge management platform. The AI tools help students to analyze the evolution of research interest in specific topics to identify emerging frontiers and declining trends.

For instance, in research targeting "new power systems", AI tools can rapidly map out theoretical research pathways encompassing fundamental technological breakthroughs, system integration with intelligent regulation, and deep convergence of digital-informational frameworks. This enables students to grasp the field's evolutionary foundations and emerging frontiers, thereby facilitating accelerated development of a structured domain knowledge framework.

At the same time, AI tools can be used to analyze the citation quality of relevant literature, helping to provide a clear quantification of academic consensus for senior undergraduate students who are not familiar with the academic field and have difficulty grasping the quality of journals and papers. Combining metrics such as time to publication, citation growth rate, and novelty helps students identify the latest, fast-moving research frontiers. Using literature search tools such as Zotero, Mendeley, EndNote, etc. can help students to organize the read literature and its extracted key information into a personal knowledge database for subsequent retrieval and review.

2.2 Terminology Learning and Translation of Specialised Materials

In the professional English for electrical engineering course, the learning of professional terms and the translation of professional materials are the core of developing students' competence in international technical communication. Breaking through the traditional vocabulary recitation mode, the course focuses on the logic of terminology generation and conceptual correlation. Through the systematization of terminology cognition and the projectization of translation tasks, the ability to leap from language understanding to technical re-expression is realized, laying a linguistic foundation for participation in international engineering projects.

(1) Terminology

Terminology teaching includes terminology deconstruction and multi-contextual reinforcement training. In terminology deconstruction teaching, we deepen the cognitive logic of terminology through etymological analysis, lexical analysis and concept mapping. In the multi-context immersion training, based on the real IEEE standard documents, we carry out the tasks of terminology dictation and fill in the blanks, and identify multiple meanings, so as to strengthen the precise application of terminology in the engineering context.

(2) Translation

Translation of professional papers, like translation of other foreign language documents, needs to achieve accurate expression of the meaning of words and sentences, and the language expression of professionalism. In teaching, representative texts such as relay protection set value reports and substation design specifications are selected to guide students to identify the characteristics of engineering English such as passive voice and conditional sentences, and to master the skills of splitting long and difficult sentences. In order to improve students' translation skills, a group activity was carried out in the

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classroom to evaluate each other's translations, focusing on checking the consistency of terminology, such as "bus", and the accuracy of the translation of technical parameters.

(3) Human-machine collaboration

With the rapid development of AI technology, different kinds of translation software have brought great convenience for students to read foreign-language literature. The existing translation software is generally accurate for basic daily communication, but AI cannot replace the essential understanding of engineering principles, and there are still barriers to the translation of professional terminology.

The students are guided to use AI translation tools properly. The machine translation of terminology errors, long and difficult sentences logical confusion, technical parameters translation errors and other phenomena are introduced. A collaborative human-machine translation model for professional literature is proposed, requiring students to pre-translate foreign language materials manually before proofreading AI translations. Human and machine collaboration translation ensures the terminological accuracy, logical correctness, and academic expression of translations.

Although AI technology has brought great convenience for translation, it is still necessary to emphasize the academic ethical norms to students. It is strictly forbidden to use AI translation directly in the course training. It is necessary to retain the traces of human-machine collaboration modification and to develop good academic habits.

2.3 Writing format for an academic paper

(1) Writing format requirements

An academic paper writing differs from daily writing primarily in its rigidly structured format. Academic papers are usually structured as Introduction, Methods, Effects analysis, and Conclusion, and are required to conform to specific specifications for the hierarchy of headings, numbering of chapters, and labeling of charts and graphs. The content and writing form of each module is strictly limited, e.g. the abstract needs to condense the full elements of the study, the introduction must declare the research gap, the analysis of effects section is prohibited from mixing in the description of the methodology, and the conclusion does not allow for the addition of new data. This style of writing dictates that students are unable to complete an academic paper based on daily writing experience.

(2) AI-assisted structural review for enhanced teaching efficiency

To address the heavy burden of format reviewing faced by teachers in course and thesis supervision, there is an urgent need to develop an intelligent template-validation engine for academic writing aimed at enhancing teaching efficiency. Currently, during academic guidance, teachers expend substantial effort manually correcting formatting irregularities in student papers, including adjustments to headers/footers, line spacing, font styles, section organization logic, and other details. This work significantly crowds out effective time for academic advising. Thus the proposed intelligent validation engine will deliver dual functional breakthroughs. For format compliance review, upon student draft submission, the system automatically aligns with target journal templates, e.g., IEEE/Elsevier formats, performs normative scans of elements like headers/footers, line spacing, and font specifications, and intelligently pinpoints deviation locations. For structural defect diagnosis, it can leverage academic writing paradigms. It detects logical gaps in section flow while providing corrective suggestions for issues like figure-table reference consistency and heading hierarchy coherence. By shifting format verification from manual to automated processes, this tool liberates teachers from repetitive tasks, allowing them to concentrate on innovative academic guidance and optimize teaching resource allocation efficiency.

2.4 Team collaboration works

After completing the theoretical teaching, the course has set up a teamwork learning effect demonstration session "Technical Document Writing" and "Virtual Academic Conference Presentation". These works systematically cultivate students' engineering English application ability, teamwork awareness and international academic communication literacy.

(1) Technical document writing

This work requires student teams of 3 to 5 members to collaboratively execute a translation project of cutting-edge English literature in electrical engineering. Implementation emphasizes three critical factors.

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The first one is terminology consistency management. Teams must establish a collaborative terminology database to ensure precise and unified rendering of technical concepts. The second one is technology logic fluency. Transcending literal translation constraints by reconstructing complex syntax through electrical engineering expertise for target-language technical coherence. The last one is translation quality control. Team members need to implement a tiered workflow including draft translation, cross review and final polishing.

(2) Virtual academic conference presentation

This part replicates the IEEE conference setting, requiring teams to deliver a 15-minute English presentation based on premier electrical engineering conference papers. Implementation emphasizes four critical factors.

The first one is content refinement. It requires students to extract core contributions, key technical pathways, and innovative conclusions from full-length papers. The second one is academic rigor. Students need to enforce standardized slide architecture, scholarly graphic annotation, and formal oral delivery. The third one is critical thinking integration. All teams need to design targeted academic Q&A design during discussion segments. The last one is team collaboration. The performance is assessed through the coordinated presenter and collaborative response strategies in Q&A sessions.

3. Key Issues in Teaching and Learning Implementation

In the professional English for electrical engineering teaching design, AI tools have been systematically introduced for academic literature searching, professional words translation and paper format verification, which has significantly improved the efficiency of technical document processing and academic training intensity. However, teaching practice shows that the in-depth application of AI technology is accompanied by two core challenges: the blurring of academic ethical boundaries and the explicit risk of technological dependence. This requires that the course design must establish a rigorous framework for technology application, and ensure the unity of technology-enabled empowerment and the fundamental purpose of education through a dual approach of ethical governance and competency cultivation.

3.1 Academic Ethics Boundary Maintenance

Academic ethical boundary maintenance is one of the most important principles of AI tool application. At the implementation level, the course sets up a triple protection mechanism.

(1) Establish source data screening specifications

Students can only input open-source technical documents into the AI translation tool. It is strictly prohibited from dealing with confidential documents involving the core parameters of patents.

(2) Implement the critical validation process of the AI output

Students are required to perform cross-checking of the AI translation results and to mark the translation with an "AI-assisted" statement.

(3) Build a guarantee system for academic originality

It is restricted the AI tool is used for a preliminary overview only. The final version must include the comparison of technical viewpoints written by human beings.

In the teaching process, it is expected to cultivate students' awareness of intellectual property protection, strengthen their knowledge of the limitations of AI technology, shape the academic value of technology assistance rather than substitution, and build up their ethical consciousness for future transnational technological cooperation.

3.2 Technology Dependency Avoidance

The course design emphasizes the core technical capability development.

(1) Translation

Human-machine collaboration is implemented in an advanced mode, where AI is allowed to translate basic passages at the initial stage. But it is mandatory for students to manually rewrite key technical

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descriptions, and then switch to manually translating the key chapters in the later stage.

(2) Literature searching

In addition to examining students' flexible use of AI tools, the focus is on assessing the ability to manually screen high-value literature and understand the academic differences between top journals and common conference papers. In the thesis format checking session students are required to fix 80% of the IEEE formatting errors manually before the remaining 20% can be reviewed using a tool such as Grammarly.

This move is aimed at achieving comprehensive enhancement of academic capacity. Students are required to make good use of AI to enhance the breadth of information processing, while maintaining irreplaceable core qualities such as terminology sensitivity and technical logic analysis through deliberate training, to avoid the risk of not being able to do academic work once removed from the AI tool.

4. Conclusions

This course design has achieved transformative innovation in the pedagogical paradigm of Professional English for Electrical Engineering. At the instructional content level, it deeply integrates three core modules: intelligent academic literature retrieval, in-depth analysis of technical terminology with precision translation of technical documentation, and internationally recognized academic writing conventions. The curriculum further incorporates AI-powered enhancements, including automated literature extraction efficiency optimization and formatting compliance verification. The curriculum innovatively designed two practical components: collaborative technical documentation translation and virtual academic conference presentations. Students experience the complete workflow from the collection and reading of technical literature to the output of academic results in a team task.

This teaching mode includes smart tool empowerment, team practice reinforcement, and ethical competence, which significantly improves the students' professional English practical level in cutting-edge fields such as new energy grid connection and smart grid. The value is not only reflected in the quantitative improvement of technical document processing efficiency, but also in the shaping of professionalism in line with international engineering ethical standards.

In the future, the course will continue to deepen three aspects, including: dynamic tracking of the efficient use of literature search tools, and the construction of real-life training scenarios for school-enterprise linkage. This initiative constitutes not only a pivotal pathway for cultivating a new generation of electrical engineers proficient in technology mastery, foreign language expertise, and ethical compliance, but also provides essential talent reserves for China's deepened engagement in Global Energy Interconnection governance.

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